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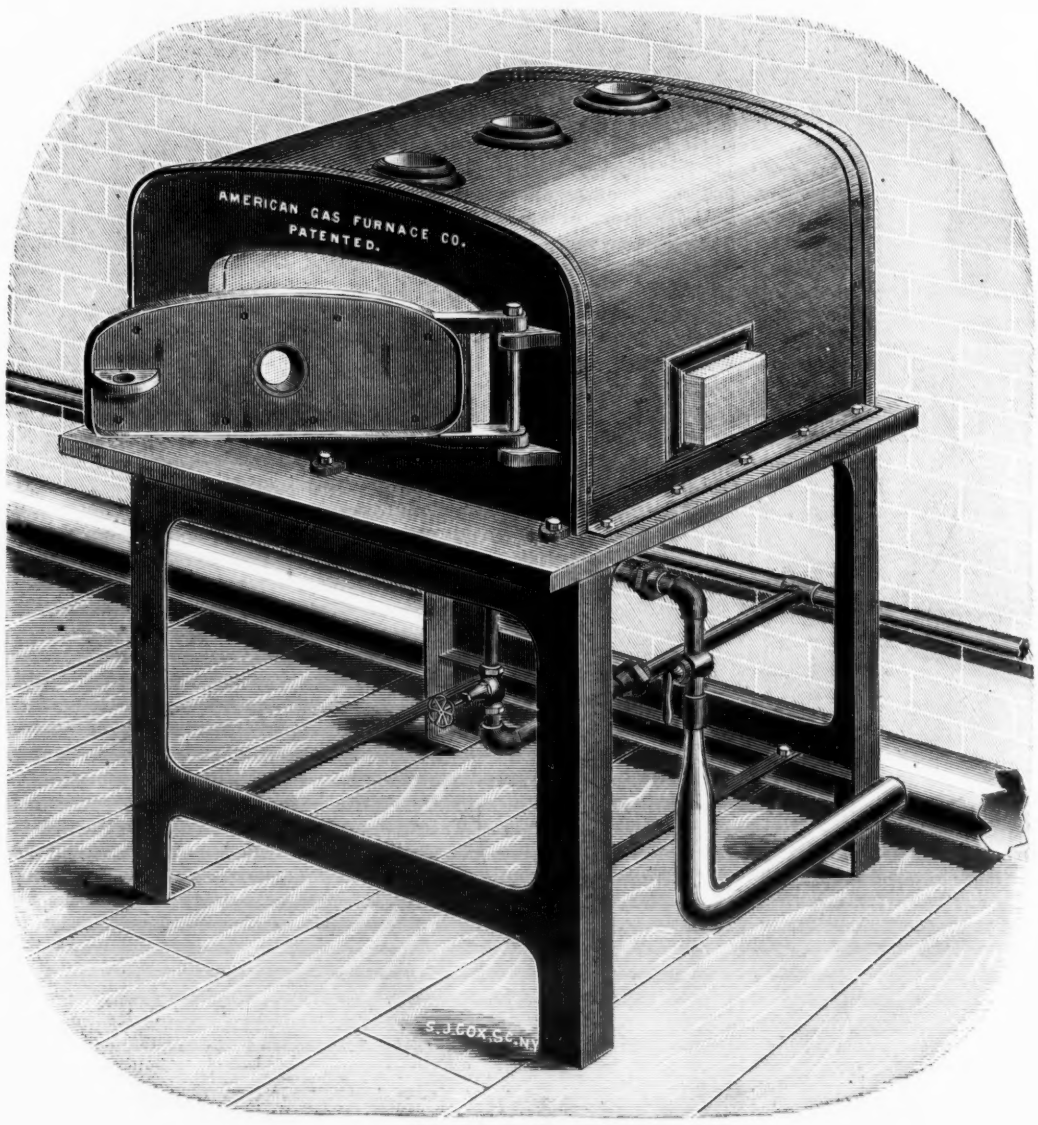
Gas Blast Furnaces.

In our issue of November 14, 1889, we showed some gas blast furnaces of various designs, built by the American Gas Furnace Co., of No. 80 Nassau street, New York. With this we give illustrations of other styles of furnaces, showing some special adaptation to particular purposes.

The principle upon which the furnaces work was fully explained in our former article, and it is only necessary to say here that heat is supplied by a mixture of gas and air, the latter being supplied at a pressure by some form of blower, while the gas is drawn in by induction just before reaching a distributing ring, from which the combined air and gas enter the combustion chamber through tangential openings, giving the flame a very rapid circular motion.

The furnace shown on this page is for use with a muffle, the general form of which is similar to that of the door in front, the bottom of the muffle being 18″x 19″ in size. Under this muffle is the combustion chamber spoken of, the products of combustion passing up about the sides, and over the top of the furnace. The furnace may be used, however, without the muffle, such a furnace having been put into the surgical instrument works of F. G. Otto & Sons, this city, in which a plain slab of fire-brick replaces the muffle, and on this the dies or other objects to be heated are placed. The heat is so distributed as to be perfectly even over the entire surface of the slab, and some large dies used for drop-forging parts of instruments, and which had been repeatedly broken by quenching them after heating in charcoal, have been hardened with uniform success in this furnace, a number of the dies being heated simultaneously. On page 2 a smaller muffle furnace is shown, which may be used in the same way, the muffle or plate being in this case 5½″x10″, and the furnace small enough to stand on a bench. Of the other furnaces shown on page 2, one was built for the steel works of Benjamin Atha & Co., Newark, N. J., and its object, as specified in the order, was, "To feed an automatic machine with ⅜″ iron rod at a white heat continuously, and at the rate of two feet per minute." The rod is inserted from the rear of the furnace, which is 4 feet in length, the burner covering half of this length, and the waste heat being utilized in preparatory heating before the burner is reached. The burner itself is graduated in strength, so that the greater heat is reached just before the rod passes from the furnace to the machine in front of it. The conditions to be filled by this furnace were quite exacting, as a white heat is next thing to melting, while, if not just white hot, the action of the machine would be interfered with. These conditions are filled perfectly by the furnace, which has now been in use for some time.

The remaining engraving is of a rivet heater, which is made for large establishments, especially where work is done by riveting machines, and it is especially desirable to keep the rivets at a uniform heat. The fire-clay slab *B*, supported by an iron disk *A*, is heated from above by the burner *D*, the heat being thrown down onto the slab *B*, on which the rivets are placed. The heat is so regulated as to bring the rivets to just the right heat by means of the valves shown. The space required is 12″ round; available space for rivets 7″ round, and the gas consumed per hour 25 to 30 feet.



GAS BLAST FURNACE.

Compound and Triple Expansion Engines.

BY JAMES B. STANWOOD.

I.

In tracing the development of compound and triple expansion engines, the most striking examples are found in the field of marine engineering, for there the advantages accompanying the saving of a pound of fuel are more numerous and of greater magnitude than in mill or stationary engineering. This will explain, therefore, why, in a paper or two on this subject, the marine engine will figure so conspicuously; for it is by comprehending thoroughly what has been accomplished here, that the principles involved can be successfuly carried out elsewhere.

It was not so many years ago that the leading type of marine engine consisted of one cylinder operating one crank, the steam pressure being about 60 lbs. to the square inch; the condensers for such engines were jet or surface condensers, according as the condensing water was fresh or salt. These engines usually propelled their ships by means of paddle-wheels. There still remain on the Sound and the Hudson River, examples of an earlier type of engine, a machine of great merit, in which the boiler pressure is only 30 lbs. to the square inch. It is doubtful whether, in point of speed or elegance, the steamers equipped in this manner have ever been greatly excelled. On our great lakes, most of the boats have been propellers, and, until within a few years, all the engines there have been of the simple condensing type, but with double cylinders and cranks, by which arrangement more regular turning can be given to the screw, and "handling" is made easy.

Six years ago, in the Atlantic service, the majority of engines were of the compound type, in which steam at 80 or 100 lbs. pressure was worked first in one cylinder, then exhausted into a second larger one, which in turn exhausted into a condenser. This type of engine, where very large power was required, often had two large or low-pressure cylinders, called on the lakes "fog cylinders"; the steam first expanding in the small or high-pressure cylinder, after which one-half passed to one low-pressure cylinder, the other to the second.

By this arrangement, known as the "three-cylinder compound," three cranks were employed, giving even turning; the size of the low-pressure cylinders for engines of large power was kept within practicable limits, the strains were relatively small, and a slightly earlier cut-off could be carried in the low-pressure cylinders. The Arizona, Alaska, Umbria and Etruria, have engines of this type.

To-day the latest ocean greyhounds have, almost without exception, triple compound engines, using steam at 150 or even 160 lbs. pressure, in all cases working with three cranks to each engine. Such engines expand the steam successively through three cylinders, though in the case of the steamer Lahn there are five cylinders operating on three cranks, the steam being first expanded in two high-pressure cylinders, passing then to one intermediate cylinder, and finally separating into two low-pressure cylinders. In the twin screw ships there are two separate engines with three cylinders each.

POWER AND PISTON SPEED.

A point of interest to be observed in the latest of these remarkable pieces of machinery is the increase in piston speed and horse-power that have been obtained.

Simple condensing engines, with cylinders of about 40-inch stroke, were run at 60 turns per minute, or at a piston speed of about 400 feet. If the stroke were greater, the revolutions were correspondingly less. This largely held true with compound engines, though in some of the later designs, especially when the three-cylinder compound type appeared, a speed of 600 feet per minute was obtained with engines of 6-feet stroke. Now, however, 800 and almost 900-feet piston speed are found. On the Saale, of the North German Lloyd line, with a stroke of 6 feet, I have counted repeatedly 63 and 64 turns per minute; this gives a piston speed of 768 feet; on the Lahn, with the same stroke, 66 to 68 turns per minute, or a piston speed of 816 feet. The twin-screw engines of the City of Paris, the stroke being 5 feet, have made the voyage with an average of 85 turns per minute, or a piston speed of 850 feet. It has been reported that these engines have been run at 90 turns under favorable conditions.

The horse-power was formerly considered enormous when an engine indicated 3,000; now, in the case of the Umbria and Etruria,

the largest horse-power that has ever been obtained from a single engine is 14,000 (at least they are so rated, probably 12,000 is as high a figure as is reached ordinarily, and even this has never obtained elsewhere). With the twin-screw steamers, 16,000 to 18,000 is the total horse-power, though developed in two engines, each indicating 8,000 to 9,000; this is the case with the City of Paris and City of New York, being rated, however, at 20,000 horse-power.

With the increase of power, piston speed and boiler pressure, there has also gone an increase in economy, due largely to the increased number of expansions which it has been possible to employ. Thus, with a simple engine, we find from 3 to 5 expansions is the average practice; with simple compound engines the expansions range from 7 to 9, with the triples from 12 to 15. The case of Corliss compound, where with two cylinders 14 to 20 expansions are found, will be considered later on. As might be inferred, the weight of these engines per horse-power, boiler, water, engine and all, has decreased; for if we can increase the piston speed, and also maintain the same mean effective pressure, a small engine will do the work of a larger one. The strains exerted on the machinery of compound and triple expansion engines are relatively much less than in simple engines, so that the running gear, frames, weight of cylinders, as well as the number of boilers, is smaller. As a result, the weight per horse-power of the entire steam plant is now about 450 lbs., where formerly it was 600 and even 800 lbs.; this, too, with a boiler pressure now of 150 to 160 lbs.

ECONOMY OF FUEL.

The important feature of these improvements is, of course, the greater economy obtained in fuel. To-day with Corliss non-condensing engines of ordinary size, it requires $3\frac{1}{2}$ to 4 lbs. of coal per indicated horse-power per hour, this being an average for a week's run. With triple expansion engines $1\frac{3}{4}$ to 2 lbs. of coal is used per indicated horse-power per hour, day in and day out, and these figures in each case are frequently lower when working under the most favorable conditions. The total amounts of fuel used per day, however, are enormous, the Umbria and Etruria burning each 315 long tons every 24 hours; the Saale developing 7,200 horse-power, and the Lahn a slightly greater horse-power, burn each about 145 long tons in the same time. The advantages obtained by triple compounding are not all on the side of economy of fuel; it is doubtful, if this advantage were lacking, whether the type would not have been finally adopted because of other valuable features.

To trace out the reason for the superior economy, and the other important advantages, is partly the design of this paper.

THE POWER OF COMPOUND ENGINES IS MEASURED BY THE SIZE OF LOW-PRESSURE CYLINDER.

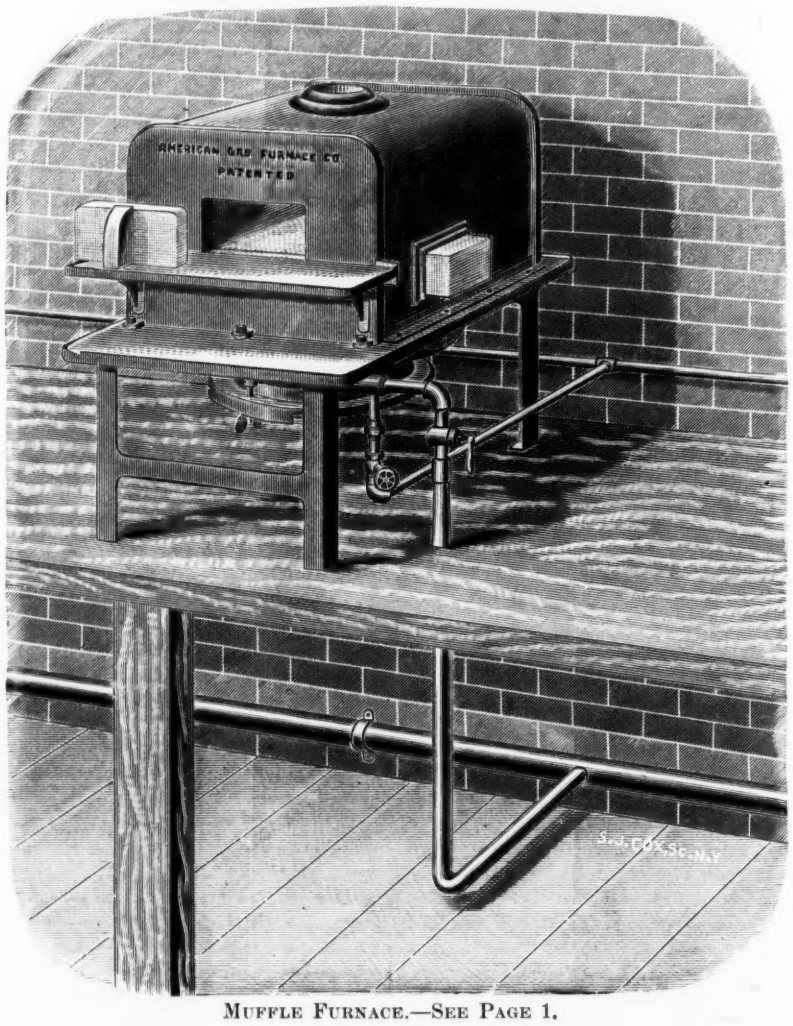
Engineers, in speaking with one another about the power of simple engines, frequently state the bore and stroke of the cylinder, by which a good idea of the power is conveyed, this assumption always being that the steam pressure, revolutions and expansions, agree roughly with general practice. So with compound or triple expansion engines, the size of the low-pressure cylinder, other things equal, gives the same idea; which means in each case that, no matter what the size of the high-pressure, or high-pressure and intermediate cylinders are, the horse-power with same boiler pressure, revolutions, and grade of expansion, is constant for a given size of low-pressure cylinder.

That the sizes of these smaller cylinders do not affect the case is shown thus: In a simple compound engine, with one high and one low-pressure cylinder, let the low-pressure cylinder have four times the cubic contents of the high-pressure cylinder. If now the high-pressure cylinder, full of steam at 80 lbs. absolute pressure, discharges its entire contents into the low-pressure cylinder, the steam will fill four times the space, and will exert $\frac{1}{4}$ of its original pressure, or $\frac{80}{4} = 20$ lbs. absolute. It has expanded four times. If only one-half the contents of the high-pressure cylinder is discharged into the low, it will fill eight times its original volume, and have $\frac{1}{8}$ of its original pressure, exerting then only 10 lbs. absolute pressure—expanding eight times. This would be the case if steam were cut off at one-half stroke in the high-pressure cylinder. Again, with the same low-pressure cylinder, let the high-pressure cylinder be larger than before—for instance, $\frac{1}{3}$ instead of $\frac{1}{4}$ the volume of the low-pressure cylinder. If its whole volume is now expanded into the low-pressure cylinder, it expands three times, and to obtain eight expansions, as above, the proportion of the whole volume discharged into the low-pressure cylinder must be $\frac{8}{3}$; for $\frac{8}{3}$ is $\frac{1}{3}$ of 3. So when the cut-off is $\frac{8}{8}$ the stroke on the high-pressure cylinder, we obtain eight expansions, the same as obtained at $\frac{1}{2}$ stroke cut-off when ratio of cylinders is 4 to 1.

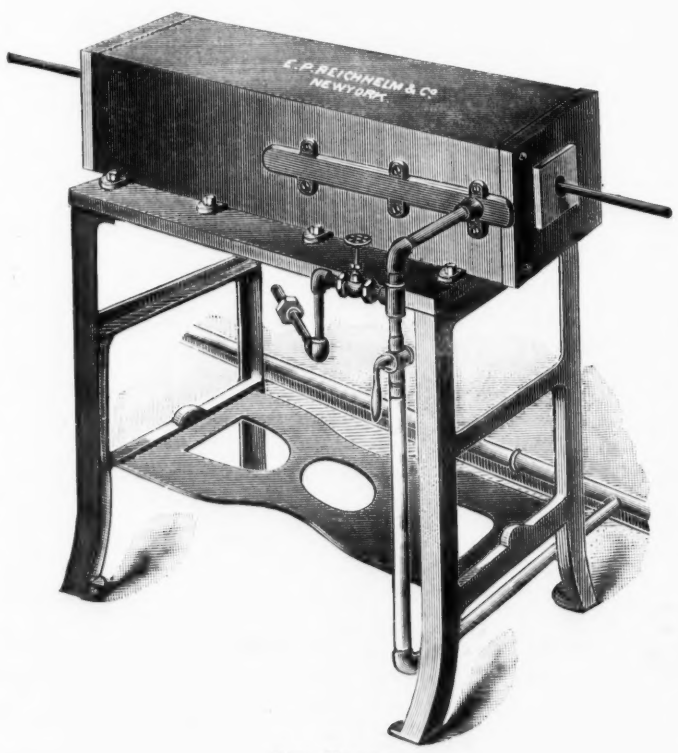
In either case, with the same boiler pressure and piston speed the same work is performed.

The size of the high-pressure cylinder and the cut-off on same vary inversely—the smaller the cylinder the later the cut-off, the larger the cylinder the earlier the cut-off for any given number of expansions.

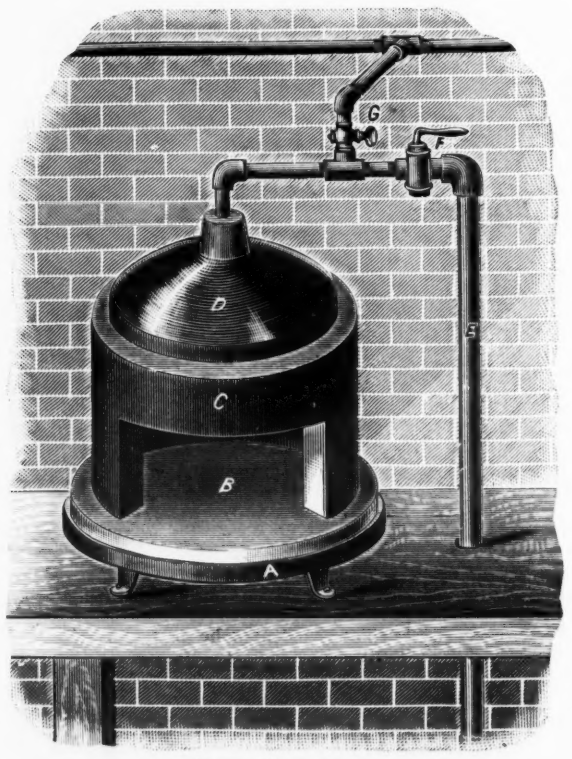
It is true, however, that a greater maximum power can be obtained in case the high-pressure cylinder is large, than when it is small, because when working at the latest cut-off a smaller number of expansions can be obtained with a corresponding larger mean effective pressure; let the latest cut-off obtainable with a given valve gear be $\frac{1}{4}$ on the high-pressure cylinder, the minimum number of expansions will be, cylinders 4 to 1, $4 \div \frac{8}{4} = \frac{16}{3} = 5\frac{1}{3}$ expansions; when cylinders are 3 to 1, $3 \div \frac{8}{4} = \frac{12}{3} = 4$ expansions. This is in no way a different case from that shown by a Corliss and a Buckeye engine with the same bore of cylinder, and same piston speed; the valve gear of the former gives the latest cut-off at about $\frac{8}{5}$ or $2\frac{3}{5}$ expansions, the valve gear of the latter gives latest point of cut-off about $\frac{8}{5}$ or $1\frac{3}{5}$ expansions; yet both of these engines are rated and operated at about 4 expansions, and give the same power, other things being equal.



MUFFLE FURNACE.—SEE PAGE 1.



ROD FURNACE.



RIVET FURNACE.

The American Patent System.

BY D. WALTER BROWN, PH. D.

WHAT IS REQUIRED OF THE INVENTOR.

I.

An inventor with a patent is not an odious monopolist; on the contrary, he is one of the world's benefactors, for he has given to the world knowledge that before him it had not, that is appropriate to the increase of its wealth and welfare.

This is the view of the American patent law, and on this idea our patent system is founded. In theory, a patent is a grant by the Government of a certain exclusive right of making, using and selling to that man who has first conferred upon the people of the Government the knowledge necessary to enable them to make use of something which, before his time, they knew not how to use. On the one hand, the inventor comes bringing the product of his mind, and publishing it to all the world on the records of the Patent Office. On the other hand, in return for that publication, the Government gives to him the exclusive privilege, for a time, of making, using and selling his invention. After that time the invention is to be free to all the world.

It is evident that this relation of the inventor to the Government involves certain indispensable conditions, and first, that the inventor shall really be, as he professes to be, the first to make known to the world the discovery embodied in the invention and claimed in the patent; for, if another were the first, then that other, and not the alleged inventor, would be he who had conferred the benefit. Or if, before our inventor had made his invention, the thing he claimed were generally known, then, as he would add nothing to the stock of knowledge, he would not have given the equivalent for a patent, and a patent to him would exclusively appropriate to him a right which had before belonged to all.

So, again, it is necessary, in order to obtain a patent, that the invention shall be useful; that is, that it shall not be purely visionary and impracticable, like a scheme for perpetual motion, nor aim at immoral or injurious results. But it is only necessary that some benefit shall be conferred by the invention—not a great one, but some. The law recognizes that, in general, the extent of the use of an invention, and the value of the monopoly of the patent, will depend on the usefulness of the patent, and it does not undertake to pronounce on the usefulness of any man's device. It merely says he must not patent

an entirely frivolous, impossible or immoral thing.

Finally, it is evident that an inventor only bestows that benefit on the world, which is the sole condition on which he can obtain a patent, when he publishes to the world so full and complete an account of his invention, that another can take that account, and from it make and use the patented thing. Without such sufficient description, the primary object of our patent law—to add to the sum of beneficial knowledge—would not be attained.

Thus the patent law requires of the inventor these three things:

1. That he shall be in fact and in truth the first inventor.

2. That his invention shall be in some degree useful.

3. That he shall publish to the world, in the records of the patent office, an account, called a specification, sufficiently full to enable others, who are skilled in the art or business to which the invention relates, to make and use the invention. This record remains for the information of the world, so that, after the limited life of the patent, all skilled in the art may freely employ the invention.

It is the theory of our law, and the fact agrees with the theory, that the Patent Office shall be a storehouse of knowledge, useful to the world's progress. The information furnished by the inventor to its records is the benefit in return for which the Government protects him in his exclusive privileges for a limited time.

The nature of this privilege, the priority of invention, and the sufficiency of the specification, will be treated of in the next article.

Shipbuilding in Britain.

Iron shipbuilding has progressed with an activity which is absolutely without parallel. In all our ports there has been an abundance, a superabundance one might say, of work. Overtime has been resorted to very generally in order to keep pace with the orders on hand; but even this device has not been sufficient for the purpose. Wages have gone up in all branches of the iron shipbuilding industry, in all the shipyards and boiler shops of the country. The actual wages in some districts, especially of the piecework hands, are described as enormous; and yet, it appears, the profits of speculators have been still more marvelous. All along the northeastern coasts the men begin the new year with a further advance in wages, and there and elsewhere with trade sufficient in hand to carry them over, or nearly over, the year 1890. Several strikes have taken place in connection with this branch of industry, in various parts of the country. But they have not been serious, as compared with former strikes in the iron shipbuilding trade. Generally the concessions have been made in a friendly spirit, and a better feeling prevails than was ever displayed before. The employers often seek the aid of the union to supply men, and to enforce contracts, and insure constant attention to work; and the union has uniformly endeavored to do its duty in these respects, in so far as it was able to do so. All concerned begin the new year with every sign of prosperity throughout the whole of the trade.—*Engineering.*

Renewal of Iron Bridges in Austria.

An iron bridge of the ordinary type broke down suddenly under a train on one of the Austrian railways. The Board of Safety immediately issued a general order for the examination, revision of calculations, and renewed testing of all iron bridges. In persuance of this order, given in 1887, the work of examining and strengthening was begun. At first, the smaller plate girders were renewed or strengthened, and quickly completed, with the smallest cost involved. The work was generally executed piece by piece without interrupting the traffic; with double lines, one line of rails was generally closed, so as to complete the work more expeditiously. On the more important long-span bridges the traffic was in a few cases stopped during the process of reconstruction.

It was found that the deficiency was most conspicuous in the bridges of 60 feet to 165 feet span, and notably those of 100 feet span; plate girder bridges from 6 feet 6 inches to 40 feet span were generally more suitable for the loads. Not considering the wear and tear of these bridges, it may be said that the two most important factors in increasing the strains have been the increase in the weight of locomotives, and the increased speed of trains; the increase in weight of the engines is nearly 50 per cent.; thus in 1848 the average weight of engine and tender was 30 tons; in 1878 it was 40 tons; and at present is 45 tons; on the State railways in 1858 the weight of engine and tender was 34 tons; 1868, 37 tons; 1878, 43 tons; and 1888, 52 tons. It is also said that the increase in the average speed of trains was at least 50 per cent. during the same period.

It is supposed that these iron bridges were originally constructed with a factor of safety not less than four; but in many cases the margin was undoubtedly much less, girders originally strained to nearly 7½ tons per square inch have of late years been subjected to a strain of 12 tons per square inch. A great number of plate girder bridges, dating from 1857, and later years, were strengthened by adding extra plates in flanges and stiffeners and flat plates on the webs, cross girders, and transverse bracing. Bridges with shallow main girders under the rails had intermediate parallel girders inserted. Other girders were trussed longitudinally from pier to pier; lattice girders with one system of diagonals were doubled, and double systems made quadruple—the new material, in some cases, being fully 35 per cent. of the original iron work.

About 250 plate girder bridges and 150 lattice girder bridges were thus reconstructed.

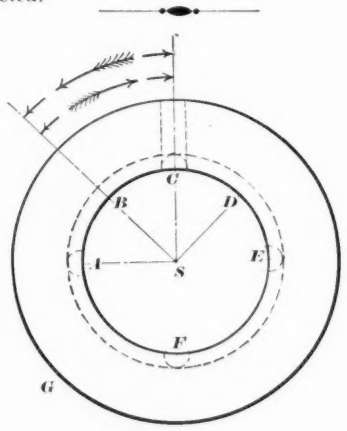


Fig. 1.

The Rock-Shaft Roughed Up—Cure.

BY JARNO.

The rock-shaft was so badly roughed that it would not turn. The connecting rod that drove the rocker arm kept a-going, which made one end of the arm move, while the other end was rigidly held by the shaft, and, in consequence, the moving end left the other behind. The maker of the shaft is the same as that of the unconscious pump. To all comers he is now ready to give a lecture on shaft oiling, a part of which runs as follows:

"Unless special provision be made to prevent, rock-shafts that do not make a complete turn are more likely to rough up than other shafts. A reason for this can be seen in Fig. 1. Let the shaft *S* make one-eighth of a turn; put four grooves, *A*, *C*, *E*, *F*, lengthwise in the box *G*, and connect them with the oil-hole *C* by a groove running around the box. Let the point in the shaft at *B* move from *B* to *C* and back; the point at *D* from *D* to *E*. The part of the shaft bearing between *B* and *C* comes opposite the oil groove *C* at each movement of the shaft, but the part between *A* and *B*, or between *C* and *D*, does not come opposite an oil groove, and, in consequence, does not get oiled, unless the oil be spread around the box and held by friction. If a shaft be oiled directly from the oil grooves, they cannot be farther apart than the distance through which the shaft moves. If the shaft be quite loose, three one-thousandths inch or more, the oil may find its way around with but one groove, *C*, in the box. But, even though loose, if the shaft moves very fast, it may pound the sides of the box, keep the oil out, and rough up. The sure way is to have grooves enough, whether straight or spiral, whether cut in the shaft or in the box, to lead oil directly to every part of the bearing, during one complete movement of the shaft."

A New Type of Marine Boiler.

Charles Bastow Casebourne, in a paper recently read before the Northeast Coast Institution of Engineers and Shipbuilders, advocated the use of higher steam pressure for marine engines. He says, after showing how much further expansion can be carried when high-pressure steam is employed:

From this it will be seen that steam of 250 pounds is capable of doing 20 per cent. more work than steam of 150 pounds, and steam of 150 pounds 25 per cent. more work than steam of 80 pounds. The latter has been proved by actual practice, and is now an acknowledged fact.

To use steam of 150 pounds pressure with a compound engine, would be very little more economical than to employ steam of 80 pounds, and the same may be said in the case of using any higher pressure than 160 pounds for triple expansion engines. Yet when 160 pounds pressure is used in the case of triple expansion engines, it may be said that there is a saving of 25 per cent. over the ordinary compound; and, supposing a boiler was adopted with 250 pounds pressure, it might be anticipated with some certainty that a saving of 20 per cent. would be effected over the triple expansion engine. At the present time quadruple expansion engines are working at a pressure of 180 pounds only. This is accounted for by the fact that hitherto it has not been found possible to construct a marine boiler capable of withstanding a higher pressure, without either considerably reducing the diameter or increasing the thickness of the shell plates."

He does not believe that the use of the locomotive type of boiler will solve the problem of higher pressures. They require the purest of water, and are apt to prime when the vessel is rolling and pitching. He does not believe that they could be placed in the same space for a given horse-power as the ordinary marine boiler. He describes the kind of boiler he thinks would meet the requirements, as follows:

Having regard to these requirements, the writer ventures to introduce to your notice a form of boiler which will bear the strain of these higher pressures without increasing the thickness of shell plates, or reducing the diameter. This is a boiler having two shells, which will hereafter be named as "outer" and "inner" shells. The space enclosed between the shells is termed a "jacket," so that the whole may be termed a "jacketed" boiler. The object of providing a double shell is to charge the enclosed space with steam of a lower temperature than that generated within the inner shell, which is thus relieved of the full pressure of steam within, and is only subjected to the excess of the pressure of steam within over the pressure of the steam between the two shells. As for example—we have a boiler with a shell calculated to stand a working pressure of 150 pounds to the square inch, employed as the inner shell of a boiler in which steam is generated to a working pressure of 250 pounds, the extra 100 pounds being neutralized or balanced by an external pressure of the same amount exerted by the steam enclosed between the two shells or jacket.

As the object of providing a space between the two shells is to provide a means of applying a neutralizing or balancing pressure to the inner shell, any fluid or gaseous body may be used; but for many obvious reasons steam is the most convenient for the purpose.

It is at once evident that the pressure in the jacket must be constantly and regularly maintained, and, in order to provide for this, it is necessary to have one or more regulating valves between the two shells. These are constructed on the principle of an ordinary spring-loaded safety valve mounted on valve seats in the inner shell, and so regulated that when the pressure in the jacket falls below that required to be maintained, the valve lifts, admitting steam from the boiler until the required pressure is reached, when the valve again closes. The valve is loaded to 150 pounds, and is externally adjustable. This is effected by having a screwed spindle passing through the cover, by means of which the spring may be compressed or released, as desired. A valve would be necessary to provide against collapse of the inner shell, should the pressure in boiler from any cause be suddenly reduced. Safety valves of ordinary construction would have to be provided for both boiler and jacket. Condensed water would be drawn away from the bottom of the jacket to feed the pumps. Tubes would have to be thicker, but not much more so than those required for 150 pounds pressure, as their diameter could be slightly reduced.

The same may be said of furnaces. These could be used of a thickness of ⅝ inch and diameter of 3 feet, and of a thickness of $\frac{9}{16}$ inch and diameter of 2 feet 6 inches of Fox's patented corrugated type. Longitudinal stays would have to be pitched closer together, and of rather larger diameter, but they need not be of lesser pitch than 14 inches, which would afford ample room for examination and cleaning inside of boiler. Combustion chamber stays would have to be pitched closer together, and of rather larger diameter.

Tube plates need not be of any excessive thickness, if more screwed stay tubes are put in. In fact, there seems to have been plenty of room for adapting the present style of marine boiler to higher pressures in all directions, with the exception of the shell, and the writer is of opinion that the double form of shell would overcome this difficulty. Although a boiler with two shells will naturally weigh more than a boiler with one, yet the extra weight will not be so much as might at first be supposed; for, by using steam of a high pressure, a boiler of smaller diameter is possible, the weight of water evaporated being less. Two forms of riveted circumferential seams have been devised, one the ordinary lapped joint double-riveted, and the other a flanged joint, flanged externally in the case of the "outer" shell, and internally in the case of the "inner" shell.

The latter form of joint has been suggested in event of any difficulty being experienced in repairing an ordinary lap joint, should occasion rise.

It has been previously mentioned that this type of boiler is specially adaptable for steam of 250 pounds for quadruple expansion engines, which are at present only using steam of 180 pounds.

This class of engine is becoming more popular every day, and may in time supersede the present triple expansion, even as the latter has taken the place of compound engines.

It appears that the makers of the Shepard foot lathe state in their catalogue that the lathe "has the longest crank ever put on a foot lathe, while the foot rises no higher than before. If you understand mechanics, the longer the crank, the more the power."

This has been gotten hold of by an Englishman, who quotes it in a communication to an English mechanical journal, saying that "this proves that Americans are not always right."

We must confess that it does prove this, if any proof were needed on that point; but we do not like the implied accusation that Americans claim to be always right, any more than other people. It is a pity that such statements regarding mechanics (which we believe to be as rare in this country as in England) cannot be kept at home, where they may be regarded more charitably.

The steamship "Gallia," of the Cunard line, experienced a remarkably rough passage in her latest outward trip from New York. Staterooms were flooded, and five life-boats were smashed, notwithstanding which, all the passengers were safely landed.

The fact is that, although there will be discomforts in an ocean voyage during a period of high storms, a passenger is just about as safe on a modern transatlantic passenger steamship as he is on land, no matter what the weather.

In letters from manufacturers, issue of January 9, the statement is made, that Jones & Lamson (Springfield, Vt.), are building over $100,000 worth of machinery for the Pennsylvania R. R. Co. The amount should have been $10,000.

In our issue of Jan. 23, in the notice of "Almond's Loose Pulley Oiling Device," we did not state that it was patented. We make the statement now, in the interest of our readers.

English Boiler Inspection.

BY W. H. BOOTH.

Though it may be doubtful practice to dispense with domes in the case of locomotives, it is very questionable indeed whether a dome is worth retaining in stationary boilers. They are a source of great inconvenience in carriage, and frequently prevent a boiler being revolved upon its seat for repairs. They do not prevent priming, as is proved by the fact that very frequently they are found heavily lined with mud, which has been carried up by the steam.

In the experiments conducted by the Manchester Steam Users' Association, a dome of 3 feet diameter and $\frac{7}{16}$ inch thick was attached by a flange to the boiler crown, only a small portion of which was cut away. The dome failed by tearing at its connecting flange, at a pressure of 260 pounds per square inch, whilst the shell itself stood as much as 310 pounds before failure. Here the dome was clearly an element of weakness, and, in view of their doubtful utility, they are just as well omitted in the best stationary practice. Where employed, they require strengthening, already fully explained, and immediately below the dome opening, and some 6 inches below the crown of the shell, a circular plate should be suspended, whose diameter should be at least that of the dome itself. Such a plate prevents any direct entry of the steam into the dome, and forces it to enter round the edge of the plate, or in a direction parallel to the boiler crown. This serves to prevent priming, which, however, is as well prevented by a perforated pipe laid along the boiler crown, and communicating with the steam stop-valve. Such pipes may be from 6 to 8 feet in length, and perforated in narrow slots along the top and sides, with a hole for drainage of entrained water on the lower side, care being taken that the area of the slots does not exceed by more than twenty-five per cent. the area of the steam outlet-valve, as in such case the action of an anti-priming pipe is often faulty.

When domes are not used on a locomotive, there is always a danger of the washing up of water into the steam pipe, by the starting or stopping of the engine, especially if bumping.

The weak point of a steam dome is its connection with the shell at the longitudinal center line of the shell crown. This portion of the shell crown is exposed to a very severe stress, from the combined action of the steam, tending to lift the dome off the boiler by upward pressure on the dome crown, by the bursting tendency of the dome itself, as a cylinder under pressure, and by the bursting stress in the shell, concentrated about the portion *immediately outside* the dome. We italicize the words "*immediately outside*" for good reason, as we hope to show.

A boiler exposed to internal pressure is made cylindrical, because, if of any other form of cross-section, it would become or tend to become cylindrical. The openings of a dome cut in the shell of a boiler have been made less than the diameter of the dome itself, in order not to remove so much of the boiler shell, and so throw the stress, which should be borne by the cut away plate, upon the edges of the hole, in such severity.

Now, whilst we fully believe the practice to be good, it must not be overlooked that, within the dome, the steam acts *outside* as well as inside the shell plate. Hence, within the limits covered by the dome, the shell plate ought to be *not curved*, but *flat*, and extend *straight* across the dome opening. Now it does not do this; and so, when called upon to bear any of the ring tension, in common with other portions of the shell, it cannot do so, for it immediately begins to flatten out; it will not stand up to its work, for no bent tension member can stand rigidly to its work. Thus, the plate of the shell covered by the dome gives way under stress, which is, after all, concentrated at and about the dome base, as though the full size of hole had been cut out. The advantage of the smaller hole is, however, real and tangible. Close within the dome the plate is almost flat for the few inches across the dome just at that part. Further, a rent is less easy to start in the body of a plate than at its edge, and so some further advantage is gained. Nevertheless, the part is weak, and should be well reinforced by an edge ring, as well as by stiffening angle irons, as seen in American practice, though I have not met with it in England.

Closely connected with the subject of shell weakening, by dome and other openings, is the question of weakening by longitudinal rivet seams, and this leads up naturally to the subject of the welding of such seams as a substitute for riveting until the time arrives for the common use of solid rolled rings of plate, which may soon be expected to be as common as solid rolled steel tires.

Whilst with riveted longitudinal seams the highest claimed joint efficiency is about 80 per cent. of solid plate, there is a possibility of obtaining 100 per cent. with a welded seam. This possibility makes the welding of boilers very inviting to the economically disposed engineer. By a perfect weld, we get rid of a source of weakness, and can reduce the weight of a boiler by about 30 per cent. Grooving at the seam is impossible, there being no seam.

It is unfortunate, however, that, even with the very best appliances, the process of welding, as applied to boiler shells, is more or less uncertain. With care, a riveted joint may be relied on to a certain calculable extent; but the weld is not so uniform, and there is always a risk, in a welded plate, of the existence of a considerable length of joint imperfectly united and yet not visible. Such a weld resembles a cold shut in a casting, and may fail at any time, and suddenly.

Some plate smiths are specially gifted in respect to making sound welds. A single such man in a boiler shop may be a treasure whose loss it would be difficult to replace; but the work of many smiths is not necessarily bad, but so uneven that every plate welded by them has to be assumed as having the strength of only the weakest welds turned out. A Mr. Bertram, of Woolwich dockyard, once took strips from welded plates which had been cut for dome openings from several boilers. The dome rings being welded just at the crown, there was a weld at the middle of each plate. Out of a total of twenty-three tested strips, of a width of 1", $1\frac{3}{8}$" and $1\frac{1}{2}$", eleven broke in the weld, and twelve broke in the solid, the whole failing at an average of $20\frac{6}{10}$ tons. Solid strips from the same plates showed $23\frac{6}{10}$ tons as the mean of eleven tests. The mean loss by welding was thus only about 13 per cent., while more than half the welds were stronger than the solid plate. The weakest pieces had more than two-thirds the strength of solid plate.

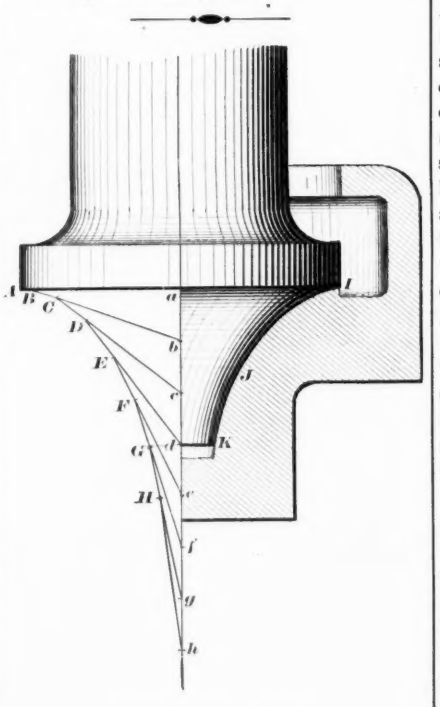
Tests by Kirkaldy on bars showed losses by welding of from 4 to 44 per cent. by one smith, and from $2\frac{1}{2}$ to $37\frac{1}{2}$ per cent. for another smith. If justifiable to argue from such limited tests as have yet been made of welded plates and bars, we should judge it reasonably safe and economical to use welded shell plates, but dangerous to use welded bar-stays or braces, the welding of which is so much less certain than that of thin plates. Welding is looked upon with suspicion by boiler inspectors when in tension, and not countenanced except in the case of small boilers, which are frequently welded.

With the great experience acquired in the building of flue tubes, and the reasonable certainty now accompanying even the welding of shells, it appears that the time has at least arrived for a series of tests to be made, which shall establish some figure as a safe working percentage of strength for large welded shells. Though far from general, the writer believes that welding is practiced to a considerable extent in America, with good results; but he has had no opportunity of seeing such boilers after being put to work.

To be good, welding of boiler shells can only be safely trusted to experienced workmen, whose constant duty it is to weld plates, and who ought never to be allowed to get out of practice. Any smith who has had a let-up on plate welding should only be allowed to get his hand in again with caution, recommencing, if possible, on internal flue tubes, exposed to external pressure only. By the use of gas, and the cleanliness accompanying it, there are far better chances of securing sound welds than with fires. The best English boiler makers, who do not use gas for the welding of furnace tubes, employ only the best oven coke for the purpose, free from sulphur, and giving a perfectly clean fire. Such fuel also is alone suitable for the heating of tubes for flanging; for the Adamson seam and welds, thus carefully made, are exceedingly difficult to detect after a boiler has worked only a short time, whilst other boiler makers turn out welded furnaces, in which the whole line of the weld is a mass of pits, hollows, and hammer marks. The soundest form of weld appears to be that in which the edges to be joined are both scarfed on the same surface, and united by the introduction of a V strip, as in the figure. Though two

welds are really thus made, the certainty of the operation is a sufficient warrant for this method, which also is perhaps the safest type of weld for shells, as well as for furnaces, presenting, as it does, such facilities for securing clean surfaces, and affording fair material on which to use the welding hammer.

At the same time, the utmost caution must be used, before exposing welded shells to great steam pressures.



Anti-friction Pivots.

The end thrust of shafting is sustained either by collars or by pivots. The propeller shaft of a steamship is subjected to a longitudinal thrust, equal and opposite to the resistance of the ship, and this thrust is usually transmitted to the collars in the thrust bearing, which is strongly connected to the framing of the ship. A vertical shaft has usually a pivot at its foot, to support the weight of the shaft, and that of other mechanism attached to it. In general, a shaft which is subjected to forces acting parallel to the axis of the shaft requires a collar or collars, or a pivot, to prevent longitudinal displacement. Pivots are made of various forms. The circular plane pivot is formed by turning off the end of the shaft square with the axis, and allowing the end to extend a short distance into the bearing. The plane surface of this pivot has to resist the whole longitudinal pressures, the velocity of the rubbing increases from zero at the center to a maximum at the periphery; and assuming that the pressure is uniform over the whole surface, the tendency will be to wear the outer parts faster than the central portion, and throw more and more pressure on the central parts. Hence it may be said that a pivot of this kind is not of stable form, but may acquire, through wear, a certain amount of stability. Pivots are sometimes made conical, and can be applied with advantage to spindles and small shafts. Again, pivots of spherical surfaces are sometimes used, especially for water-wheel shafts, and give good results. But all these different forms of pivots do not wear evenly, and on this account may give, in special cases, more or less trouble and annoyance. When an even wearing away of the shaft and its step is desirable, the so-called anti-friction pivot, shown in our illustration, can be applied with advantage. The form of this pivot is a surface of revolution generated by the revolution of a curve *I J K*; this curve is called the "tractory," or "tractrix." For the pivot shown in the illustration, the curve or "tractrix" *I J K* may be described as follows: Draw the line *A I* equal to the maximum diameter of the proposed pivot, and through its center *a* draw a line *a h* perpendicular to *A I*. Place the drawing in a horizontal position, and on the point *I* place a pencil point affixed to a heavy weight; attach a string to the pencil, and allow the free end of the string to reach the center *a*, no more and no less; then move the free end of the string along the center line *a h*, drawing the pencil-point after it; the pencil-point will describe the tractrix. The geometrical method of describing this curve is as follows: After the maximum diameter *A I* of the pivot has been determined, and the center line *a h* established, lay off on this center line, commencing from *a*, a convenient number of equal parts, thereby obtaining the points of division *b*, *c*, *d*, etc. From the point *b* as a center, and with a radius equal to *A a* (one-half of the maximum diameter *A I*) describe a short arc cutting the line *A a* in the point *B*; join the points *B* and *b* by a straight line. Again from the point *c* as a center, and with the same radius as before, describe a short arc cutting the line *B b* in the point *C*; join the points *C* and *c* by a straight line. These lines represent tangent lines to the curve. The other tangent lines are obtained in a similar way; that is to say, from the points *d*, *e*, *f*, etc., as centers, and with a radius equal to *A a*, describe arcs, each one intersecting a preceding tangent. A curve drawn tangent to the lines *A B*, *B C*, *C D*, etc., will be approximately the tractrix. The smaller we make the divisions *a b*, *b c*, etc., on the center line *a h*, the closer will the curve approach the true form. A close approximation will be near enough for all practical purposes.

This curve was proposed for pivots by C. Schiele, and it is therefore frequently called the Schiele curve. It is said that Mr. Schiele detected the form by observing the shape of worn steps which always tended to assume a form similar to that shown in the illustration; and he proved the correctness of his conjectures by experimenting with friable material.

The moment of friction of a pivot of this form is one-third more than that of a flat rubbing surface whose diameter is equal to the diameter of the maximum cross-section of the anti-friction pivot; consequently the latter will require somewhat greater force to turn it in its bearing than is required for the circular plane pivot. But the valuable property of the anti-friction pivot is that the wear due to friction is the same at all the elementary rings into which the bearing surface may be conceived to be divided. The moment of friction is independent of the length of the pivot; we may therefore make the length *a d* of the pivot to suit any practical requirements, without considering the moment of friction, which will remain the same for all lengths.

This curve can be very advantageously applied to the faces of collars subjected to heavy thrusts; when the faces conform to this curve much better results will be obtained than from radial faces.

Pivots of this form are often used with good results in boring mills and other machinery in which a steady and true motion of the spindles is required.

Large Flooring Machine.

The machine shown herewith has been specially designed for the production of flooring, and will produce from 20,000 to 30,000 feet of flooring per day, according to the character and width of material to be worked. It is thoroughly adapted for working all kinds of white and yellow pine flooring and ceiling.

The cylinders with their journals are made from solid forged steel, slotted on all four faces, and with chip-breaking lips for working cross-grained lumber, mouldings, rustic siding, etc. The journals are large in diameter, carry large driving pulleys, and run in bearings that are exceptionally long, and finished in the best possible manner. The upper cylinder carries two belts, the lower cylinder one, all driven from the same countershaft.

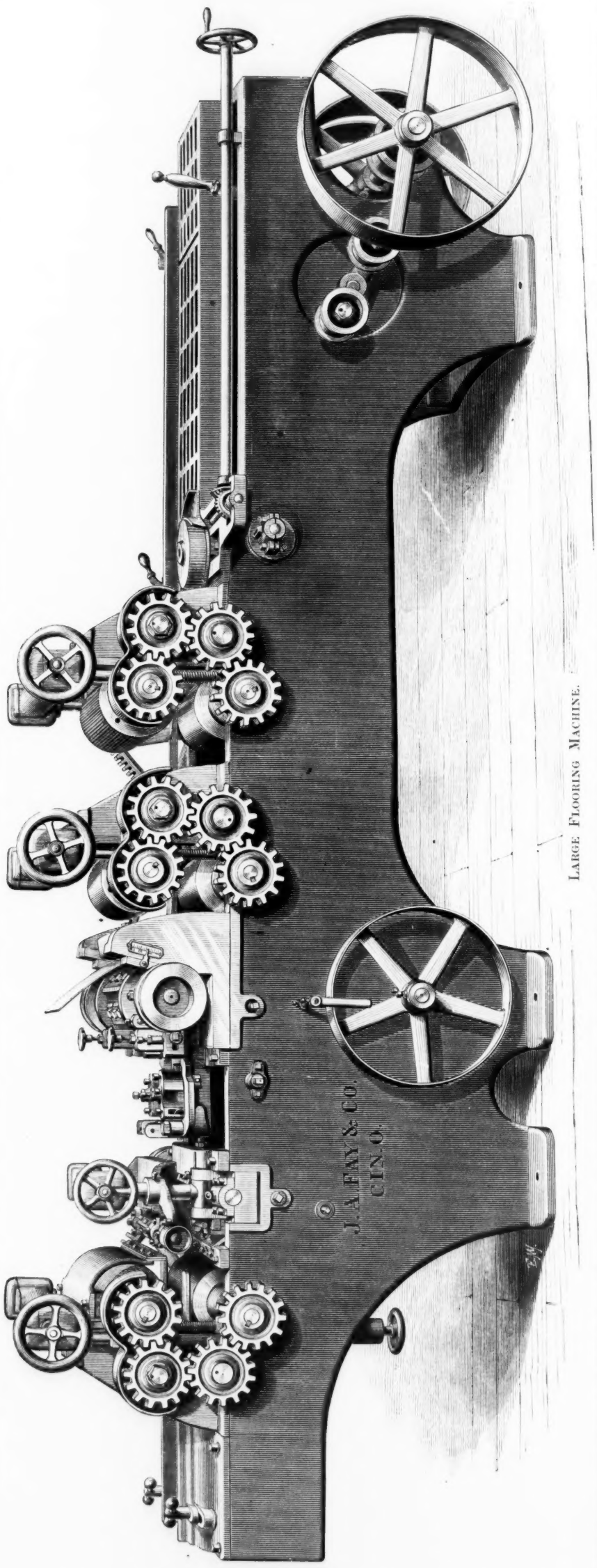
The bearings of the upper cylinder are very heavy, and planed to fit upright stands, which are cast solid to a bed, extending across the machine, which ties them together in the most rigid manner. These stands are fitted with a groove, in which the bearings are bedded, which retains them always in line. The lower cylinder is arranged in front of the last pair of feeding rolls, close to the matchers, so that all the cuts upon the lumber are made relatively near each other, insuring especially nice work. It is also mounted in a heavy frame, with delivery spout for the shavings, and has a vertical adjustment up and down by means of crank and screws, and is belted from the countershaft with open belts.

The pressure bars before the cut, or on the leading inside of the upper cylinder, are attached to swinging arms, by which the bar is brought very close to the edge of the cutters, thus preventing tearing and splintering in cross-grained or knotty lumber. This bar is so attached to the swinging arms that it can be set forward or back to admit of working moulding or drop siding cutters. The pressure bars upon the rear side are also adjustable back and forth. The bed under the upper cutter is made so it can be detached for the purpose of replaning or adjusting when worn out of line by use. The one for the under cylinder is easily removed when access to the cutters or pressure bars is desired.

The matching works are massive, and of the most substantial character. The arbors are of steel, especially large, and run in long, self-oiling bearings, both of which are adjustable laterally across the bed plate, and prevent unevenness of wear. They also have a vertical adjustment in the lower box to take up end play of the spindles. Each matcher hanger is fitted with a gauge marked in inches, for facilitating their adjustment to suit different widths of material. There is a chip breaker or clip which is indispensable for working cross-grained and knotty lumber, and producing rapid and accurate work. The matching heads are made of gun metal, with steel screws, and patent solid milled matching cutters, and are so arranged that a deep rabbet can be made with them for drop siding. The Shimer patent matcher heads can be used on this machine when so ordered.

The feed works consist of six rolls of large diameter, two pair before the main cylinder, and one pair after the lower cylinder; these carry the lumber entirely through the machine, always keeping the board in a straight line. These feed rolls are mounted upon planed upright stands, fitted with socket joints, and connected by heavy expansion gearing. The gears are mounted on expansion links, connecting the upper and lower shafts, and will open to receive 6" material. The system of expansion, as well as the method of hanging and weighting the upper feed rolls are new features. The weighted levers are inside of the frame, and move with entire freedom. The feed of the machine is very powerful, the rollers being large, and the belting, gearing and weighting so proportioned as to allow no slipping. A new and important feature of the machine is a patent power-driven edge feed and guide roll, for carrying the lumber to the first pair of horizontal rolls. This is of advantage over the old method, as the lumber is moved in a straight line to the first receiving rolls, even though warped and crooked.

The improved adjustable geared board guide which extends the entire length of the machine is a feature of importance for adjusting the matching heads to different widths of material in working flooring, ceiling and beading. With its aid a change in the position of the guide and matcher heads relative to the knives on the cylinder can be readily made, avoiding the necessity of regrinding and adjusting the knives until they have become worn uniformly their entire length. This insures an equal wear on the platen, pressure bars and feed rolls. The guide is controlled by the operator at the feeding-in end of the machine, and the index in the platen indicates at a glance the width of material that may be worked by the matcher heads. The matcher hanger on the left hand side has an independent adjustment in connection with the left hand feeding-out guide, and both matcher hangers are adjustable independently or simultaneously from the side of the machine if at any time it may be desired. A lock attachment placed on the side of the frame secures the matcher hangers properly on the frame after being placed in position. The guides on each side at the feeding-out end of the machine have independent adjustment.



LARGE FLOORING MACHINE.

The adjustable beading attachment, which is shown mounted in the pressure bar, over the under cylinder, is not furnished unless so ordered; for the reason that beading cutters can be used on the slotted cylinders if desired. Weight of machine 7,400 lbs. The builders are J. A. Fay & Co., Cincinnati, Ohio.

LETTERS FROM PRACTICAL MEN.

Temperature of the Feed Water before it enters the Economizer.

Editor American Machinist:

In the AMERICAN MACHINIST of Dec. 26th, Question 475, the query is: "In determining the result of a boiler test, should the temperature of the feed be taken before passing through the economizer, or after coming from the same?

This reminds the writer of a boiler sale in our mill a few years ago.

It was a new design and now gone entirely out of use. They offered to guarantee that it would evaporate 10 lbs. of water from 70 degrees of feed to steam at 70 lbs. pressure with one pound of coal.

We paid for an economizer afterwards entirely separate from the boiler, and after the bargain for boiler was made.

When the test was to be made, the parties claimed that they should claim the benefit of the economizer, as the heat came from the boiler. I replied that they did not furnish the economizer with the boiler, that it was something that we proposed and put in ourselves, and that it would not be allowed.

After the test was made the evaporation showed but a little over 7 lbs. of water from 70 degrees of feed. As there was no means of finding the temperature of the feed after it had left the heater, and as the difference would not have brought it up to their claims, nothing further was said about it. If it had come up to the claim it would have been a question whether they had carried out their contract. W. E. CRANE.

Waterbury, Conn.

Catching Threads.

Editor American Machinist:

Mr. Baker and F. J. F. have each furnished a rule for catching threads on lathes, both of which are very good, and would help the lathe hand to "while away the weary hours" when work is slack. When work begins to pick up a little he could reverse his lathe and run the carriage back with the screw, and get there a little quicker.

Now, here is a rule that will operate when business is real brisk, and the man has no time to go hunting for the least common multiple, and the boss would kick if he caught him reversing his lathe: Gear up the lathe and set the tool as usual, then run the carriage back towards the tail-stock until the tool passes $\frac{1}{2}$" or so beyond the end of the work, close the nut and run the lathe forward, until the tool is in the proper place to start from to cut the thread.

If the lathe is not provided with a stop for the carriage, move the tail stock up till it just touches the carriage in its present position, and put a chalk mark on the face plate, and a corresponding one on the head-stock, then go ahead and chase the thread any length you wish, and don't stop the lathe till it is finished.

To catch the thread, run the carriage back to the starting point, and if the nut will close when the chalk marks coincide, you have caught the thread, and if it won't close the first time, try it the next, and so on until it

will. This method is not new. It is used in many of the shops in this country. The operator must be thoroughly awake, and the only mathematical instrument needed is a piece of chalk. JOWNCES.

Editor American Machinist:

I have a rule that I find to be useful in "catching threads" on lathes, and find it handy and easily understood.

In cutting fractional threads, when the fraction is reduced to its lowest term the denominator of the fraction denotes a number of inches that the carriage can be run back and "catch threads." This might not be the shortest distance, so I send the conditions:

Reduce the number to an improper fraction, the pitch of lead screw being an even number. Should the numerator of the fraction be an even number, and not a multiple of the pitch of lead screw, one-half of the denominator would be the shortest distance carriage could be run back and "catch threads."

Should the numerator be an odd number, the denominator would be the unit. Should the numerator be a multiple of pitch of lead screw, divide denominator by pitch of lead screw for shortest distance.

Example.—Screw to be cut $3\frac{7}{18}$ *P.*

Lead screw 6*P.*

$3\frac{7}{18} = 4\frac{6}{18}$, $6\frac{1}{3}$" being the shortest distance.

The tool would move over 23 threads of the screw being cut, and the nut 39 threads on the lead screw.

Example.—Screw to be cut $4\frac{4}{5}$ *P.*

Lead screw 4*P.*

$4\frac{4}{5} = 8\frac{4}{5}$, $1\frac{1}{4}$" being the shortest distance.

I find it a good plan sometimes to put a chalk mark on face plate or chuck, as the case may be, and one on the gear on lead screw. I place both marks over the centers, so as to note the position of each when I throw out the nut. If I choose to run the lathe with the nut thrown out I can do so without "losing my bearings."

When I get ready to throw the nut in again, I can turn the lathe till the marks come to their positions again, and then I know I am safe. A MECHANIC.

Grindstones.

Editor American Machinist:

Owing to a separation from Mr. John E. Sweet of several hundred miles, I must refrain from patting him on the back for his sentiments regarding grindstones and wet emery tool grinders, as published Jan. 9th. I had a small dry emery wheel—tool-grinding grade—set up beside our 16" wet grinder, and the men all took to using the little wheel, and let the grinder dry up and get rusty. Taking the trouble to ask some of the men why they did this, I got such answers as, "Grind on that thing!" "Not if I can get out of it." "Do you think I want a shower bath with my clothes on?" "That's no good!" and others of like import; showing their feelings toward the wet grinder. It was not that the thing was neglected and allowed to get out of repair; the men *don't like it*. It has been trued up regularly, fussed over, and been kept clean and in good order, which is more than can be said of one *grindstone* in five thousand in use in a machine shop.

I would like to find out *why* it is that a grindstone receives so much abuse, and so little consideration. If it is a necessary evil in the shop, seems to me it should be kept in the best possible condition, thereby making what little value it possesses more readily obtainable.

Did any one ever hear of a new belt being put up to drive a grindstone, if there was an old rotten one within reach, or ever see a new pulley, which fitted the arbor used, when there happened to be an old, cracked one around, which could be bushed with a tomato can? I have worked in twenty-seven shops where they used grindstones, and have seen a five-foot stone, which ran out seven inches. Some of the boys would get on the front side with their little lathe tools, nod their heads, and time their nerves to miss the spaces and hit the lumps (*à la* Chordal's machinist boring the taper hole), mayhap with the forlorn hope that patience and perseverance might true the thing up; but hope be blamed. Some mullet-head would come along with an old pinch bar, or the stump of an old side tool made of $2\frac{1}{4}$" x$1\frac{1}{4}$" stock, get around on the back side, and toboggan over the surface, making it worse than ever.

I had never before heard of the little high-speed grindstone, and suppose it is trued up *dry* with an ordinary spur dresser; but I have experienced the discomforts of grinding on the new-fangled hydraulic machine, and the pleasure of sharpening tools on an old-fashioned grindstone, properly speeded, which was supplied with plenty of good, clean, fresh water—not mud—and turned off *every day*. W. H. CHAPPELL.

Chicago, Ill.

Roll Bearings.

Editor American Machinist:

In Question 7, issue of Jan. 2, J. R., Montreal, Can., says he has trouble with his feed-roll bearings. Now, could he not let the feed-roll bearings roll on other large wheels, which may be put on the frame in some way? By having those wheels rather large, and use as light arms (or spokes) as possible, these wheel journals will not be likely to get too hot for oil. HERMAN FERNSTROM.

Coating Wood with Glue—Preparing Brushes.

Editor American Machinist:

As far as I can learn, it is not generally known that alcohol will not cut or soften glue. I have turned out a pine wood bowl of convenient form for bench use, and coated the inside with glue, thus making a serviceable shellac can for use in the pattern shop. Even a well-made box coated the same will serve as well.

I have often been bothered with new brushes shedding their bristles; it is well to use them in the glue-pot until they become thoroughly filled, then wash, and you have a brush that will not drop its bristles in shellac. C. O. TRASK.

An Error in the Formula.

Editor American Machinist:

Mr. W. H. Booth has made a bad mistake in his article on Air Pumps, in your issue of January 16. He gives the formula for computing the velocity of falling bodies as $32 \times t^2$, whereas it should be $32.2 \times t$. This will give a velocity of 5.72 feet per second at the end of .178 seconds, instead of one foot, as he has calculated it. It would be interesting to see what results would be obtained with this error eliminated.

GEO. L. FOWLER.

Some Questions about Grindstones and Emery Wheels.

Editor American Machinist:

In every field of investigation we are all in danger of thinking that we have settled forever all that is related to the question before us, when perhaps there are miles of facts yet undiscovered, and what we have thought by careful trial to be worthless, some other fellow has made very valuable.

Professor Sweet speaks of being "terribly perplexed with the emery wheel problem," and seems to have thoroughly settled that problem, so far as he is concerned. There are, no doubt, others who are "terribly perplexed" with this same problem, and like him are justified, I think, in casting aside the average emery wheel and tool grinder; but, if we are progressive, we should not stop all further search after truth as to the relative merits of emery, corundum and grindstone grit, and the possibility of using them in such form that they will serve our purpose better than at present.

Some one has said that "it does not take twenty years for men to change their opinions of things which had seemed to them the truest and the most certain." A bold search after truth in this field may result in changing the opinions of many of us as to some points that had seemed to us the most certain.

To encourage thought, and, if possible, obtain more light upon this problem, the writer will ask some questions that he trusts will be answered by some of your readers.

Why do we not run a grindstone as fast as we do an emery wheel? Would a grindstone produce any finer or brighter surface run at a high speed than at a slow speed—if so, why? What should determine the speed of a grindstone? Should an emery wheel run any faster than a grindstone—if so, why? Is it simply because the material is called emery, and what should determine the speed of an emery wheel? Right here I will ask, What determines the speed of any cutting tool—is it not simply a question of holding its edge against the friction of cutting? Are not our opinions as to the speed of emery wheels somewhat shaped by a familiarity with polishing wheels—in other words, do we not confound the two, grinding and polishing? Does not the purchaser of an emery wheel many times select it with a view to its durability rather than to its ability to remove the greatest amount of steel in the shortest possible time, and are not the manufacturers of wheels influenced by this to make them too hard to work well?

Does the fact that we are more accustomed to the use of grindstones for tool-grinding have any weight in our decisions? Has any one ever tried to "use grindstones in every place where we use emery wheels?" and is he quite sure that he knows of all the "places where we use emery wheels"? Has any one ever tried to use grindstones where very sharp, sensitive cut is required, where the cutting pressure must be very slight, and the grinding done dry at the same time without undue heat? If so, how do they compare with a properly prepared emery or corundum wheel, and how about the difference in time and the quality of the work?

It is not true that, to make a just comparison between the value of grindstone grit and emery or corundum for grinding edge tools, each should be used under exactly the same conditions; that is, they each, as cutting particles, should be used until they have ceased to cut freely and no longer. The size of these particles, or the average path they cut should be identical, should it not, in order to make a just comparison?

Did any one ever try an emery or corundum wheel and grindstone under these conditions, or have the emery wheels usually been coarser than the grindstones, and have they not usually held their cutting particles until they became too dull to cut freely, and have not these particles many times been so mingled with gummy and non-cutting material as to cause heat, while the grindstone with which they were compared crumbled away as fast as its particles became dull, constantly presenting new cutting points without the friction of non-cutting material?

Does it make any difference with the quality of the cutting edge, whether it be ground by emery, corundum, grindstone grit, sand or oil stone, if the grain of the cut is exactly the same size in all cases, and the temper is not drawn?

Should not a wheel that required truing "once or twice a day," be condemned as poor, and a better one with uniform texture tried in its place? Will a really good wheel require truing as often as the average natural stone, and for tool-grinding should it be so hard as to require a "fifty dollar diamond"?

If a grindstone that does good work can be trued by the use of the threaded roll truing device, then should not an emery wheel, to be compared with it, be such as to be readily trued by the same means? Will not the hardest and sharpest cutting particles, other things being equal, remove steel faster than the softer and duller ones? Should we not, in the interest of progress, make our comparisons as to the merits of the different materials themselves, and see to it that they are so made up as to perform their work to the best advantage, and not condemn them without searching for the best way in which to use them?

Is it not true that great possibilities are suggested, when we consider the multitude of forms, mixtures, grades and combinations that are possible when we manufacture cutting particles into cutting wheels? Can we afford to throw aside all further investigation, because we have "never seen an emery wheel that would bear a comparison, etc."? Has any one ever seen an emery or corundum wheel that would not only bear a comparison, but cut freer and leave a better edge? Has any one ever used two such wheels on one arbor supplied with clean water—one coarse, free cutting to remove stock fast, the other as fine as a grindstone ready to put on a fine edge? If so, how about the time consumed in shaping and edging tools, compared with the grind stones? C. H. NORTON.

Centrifugal Pumps.

Editor American Machinist:

In a communication in your issue of Nov. 14, 1889, I spoke of the satisfactory work done by properly constructed centrifugal pumps. Let me mention a few of the requirements of construction:

The bearings on each side of the pulley should be in length five times their diameter, as the shaft must be made small, on account of the speed at which it is run. They should be made so that the lubricant is continually circulated, and not wasted. They should be made to keep the shaft central while following up the wear, and, if of babbitt metal, the grade known as "hard genuine" should be used. The collars which prevent the fan from striking the case should be faced with rawhide, especially if the pump is used under pressure.

The pulley should be about the diameter of the fan, and one-third of diameter in width of face. It should be provided with flanges on each edge; not ordinary straight flanges, but what are known as leading flanges, which lead the belt without permitting the edge to ride up. This point is quite important, for this reason: fan pumps are used to pump liquids, and sometimes the belt will get wet. The instant the belt is wet it slips. Without leading flanges it runs off, and against the stands; ruin of the edge quickly follows, and if the belt is not spoiled it never runs true again. Of course a belt cannot be run wet, but with this pulley the accidental wetting of the belt for a few minutes does not involve the stoppage of the pump.

The diameter of pulley is about twice that ordinarily used, but this is perfectly admissible, so long as the belt speed does not exceed three thousand feet per minute, and this speed will raise water to any height desired.

The packing-box and sleeve bearing which is supposed to carry the shaft, next to the fan, is another delusion. As ordinarily made, the shaft fits the sleeve and a spanner nut bored out to receive packing is screwed on the outside. The job is completed by a highly polished brass oil cup, tapped into the sleeve. I wish that the manufacturer could be made to force oil from that oil cup into the sleeve bearing when the shaft has cut it out so that water is coming out under pressure.

The packing should be placed as near the fan as possible, and tightened by a follower lined with the same metal as the bearings, and long enough to form a steady bearing for the shaft; this could be kept lubricated, as the water need not reach it.

The foregoing applies to horizontal centrifugal pumps; I may have something to say about submerged vertical pumps later.

A. H. LEFEBVRE.

A Word for Moulders.

Editor American Machinist:

In the AMERICAN MACHINIST of December 26th Mr. Wathey has an article, "A Word to Moulders." In it he says he was almost convinced that the moral status of the moulders of the present day on the average was not above what it was in the days of our fathers. Where there is an effect there must be a cause, and where cause and effect are not of a character to please, there ought to be a remedy.

Mr. West says some people have an idea that a foundry is a place to dump sand and blockheads. I once heard a man remark that the proprietor of a manufacturing establishment, in selecting some apprentices for his shops, selected several boys for different

departments. Among the applicants were a couple of tough-looking customers. After looking them over he said *he thought them fellows would do first-rate for the foundry.* This might be one of the causes why so many men in the foundry are a little wild.

Mr. Wathey need not go back to old England. There are plenty of landlords in this country who would feel easier if the moulder, or dude either, would plank down his board in advance. I think, with Mr. Wathey, that the surroundings of the moulder must have something to do with his recklessness. In the first place, as Mr. Wathey says, note the difference in the way in which the machine shop and foundry are fitted up. Without referring to any particular shop, I will speak of them as a general rule. Go into a machine shop or pattern shop, and you will find a trough for men to wash in, closets and pegs on which to hang their clothes, drawers in which to keep their tools, heating apparatus to keep them comfortable, all the latest tools and appliances to expedite work, and as for light there is no lack. Now go into the foundry and note the contrast. When, after his day's work is done, the moulder wishes to wash, he can do so, providing the old foundry bucket will hold water long enough; or he can wash in the bosh—it don't matter if it is a little muddy. Then he can hang his towel against a dust-covered wall. If he comes to the shop with a change of shirts he can hang his clean one on the same old spike with his towel and coat, or else he can hide them all on the cupola loft. And his tools. Well, perhaps he can find an old box or paint-bucket lying around loose somewhere, or he can hide them in some flask. As for heating apparatus, an old stove or two, without pipe, for heat, and a lot of loose fitting doors and windows, for air. As for light, there is nothing like the little tin lamp with plenty of rotten oil. What the lamp don't furnish in light it makes up in smoke. The moulder can stand it, I guess.

A certain mechanical engineer once said the foundry is the scapegoat of every institution, and I sometimes think it true. If the superintendent don't feel well he will give the foundry a send-off. In many places the common courtesy that is given to other mechanics is often denied the moulder. In speaking to a proprietor about this the other day, he said one reason for this is, they are continually coming and going, and we barely get to know them, when they are gone. I am free to confess this is too often the case. But then there is another side to this. As soon as some firms get a little job, they will crowd on all the hands possible, and will often advertise for them; then as soon as the job is out they will lay them off. The moulder is turned adrift, and he involuntarily becomes a wandering Ishmael.

When visitors are shown about the shop, they are shown the machine shop, and the machinery and its working is explained; the other departments come in for their share of show also; but when the guide arrives at the foundry door he will say this is the foundry, and will hurry the visitors by as though it were a pesthouse, and not infrequently might be heard the remark—those moulders are tough customers, and in this way the impression has gone abroad that the moral status of the moulder is of a lower standard than that of most other trades.

Truthfully speaking, there are no warmer-hearted men living than moulders. They very seldom allow one of their number to suffer; they will help one another, under all circumstances. Taking it all in all, the moulder has so many things to contend with that he has become in a manner a sort of a restless creature. If proprietors of shop would give the foundry a little more attention (outside of squeezing dollars out of it), look a little more to the comfort of the men, give them to understand that they recognize their work as of a nature that requires judgment and skill, a great deal could be done towards elevating the standard of the men. In all trades and professions there are some who are failures—morally speaking. The railroad engineers, the draftsmen, the lawyers, all afford examples; and yet no one is heard to speak of their trade or profession as bad in the main. On the other hand, if a poor sand rat gets a little too much, the first thing you hear is, those moulders are hard cases.

Mechanical papers are devoting their columns to the foundry; scientific ways of doing work are being introduced; moulders are beginning to study their trades better, and more thinking and reading men would be found in the foundry if proprietors would be as particular in selecting boys for the foundry as for other departments. I know a firm who, when they wanted apprentices, would advertise for a boy, and the applicants would be examined as to his morals, and as to his mental and physical qualities. He was given certain mathematical problems to solve, and the boy having the highest per cent. in the examination got the job. He was taken on trial for a certain length of time, and if he showed an aptness to learn he was retained. In this way the firm got good sound boys of good moral character. If this plan was always adopted the trade would soon stand second to none.

F. B. SHAFFER.

Pattern Making.

BY P. S. DINGEY.

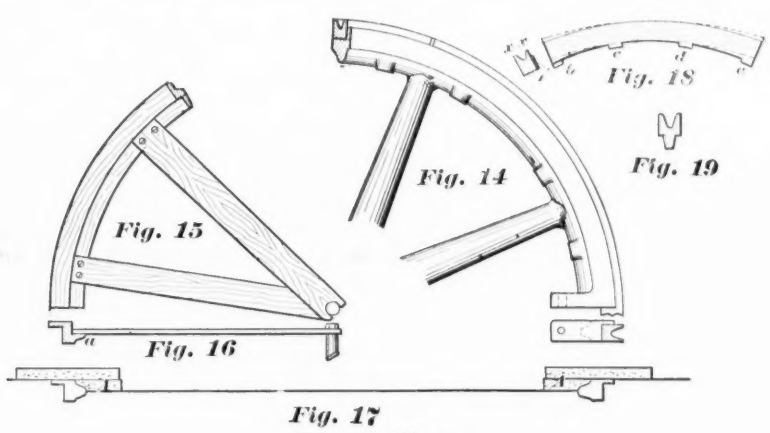
SHEAVES—THIRD PAPER.

The sheave I referred to at the close of my last paper is shown here in Fig. 14. This style is intended to work horizontally, but can be used otherwise as well; it can be made considerably cheaper than those I have already described. Dispensing with the groove that receives the segments makes it very simple to mould, and also easier for turning the periphery of casting. The plan for forming the arms and hub is the same here as in the other sheaves already referred to, so that it will not be necessary to go into that part again. The segment pattern for making the green sand part of mould is seen in Fig. 15, of which Fig. 16 is an end view. The pieces that run to the center are not screwed on the top of segment in the usual way, but on the step that is made in the segment at *a*, Fig. 16. By making it this way a large part of the rim can be rammed up in green sand, as shown in Fig. 17. If it is desired not to ram up the inner part of the rim in green sand in the drag, the same core-box that is used for the cope cores *A* can also be used for the drag, but the moulder that may have the making of these sheaves had better be consulted on this point, for there is no accounting for taste. Opposition to the ideas of others is a rather common practice among moulders and pattern makers. In no other branch of the machine business is it so necessary that ideas should harmonize, as in the instance of the moulder and pattern maker; and yet how often they are found running counter to each other's wishes. I make these remarks in passing, that both moulder and pattern maker may, if possible, see themselves as others see them.

The core-box for core *A* has been described in previous papers. The segment that is bolted on the periphery of this sheave is moulded the same way as those shown in my last paper, but the pattern is made differently—there are no chipping strips except those on the inside at *b*, *c*, *d*, *e*, Fig. 18. On one side *f*, stock for planing the side is allowed, so that the segment may set straight against the flange of wheel.

I had some little experience with the first lot of this kind of segments that were cast; I had no trouble with those that had been made like Fig. 19, but when the first lot of those in Fig. 18 were being fitted on the wheel it was found they had straightened out some, just as represented by the dotted lines in Fig. 18. It was evident that these segments straightened in cooling, because the two thin flanges * * cooled first and pulled the casting out of its true circle; the next I took care to allow for this when making the pattern; it will be seen why those in Fig. 19 kept their shape.

When there is a number of these sheaves to make, instead of closing the top with slab cores, as I have shown, it would pay to make a cast-iron plate or ring to cover the top with. This ring should have a number of spikes on one side; on this side a thick coat of loam is struck off level, dried and blacked; it will probably be easier for drying and handling to make this ring in halves.



PATTERN MAKING.

George D. Reynolds.

George D. Reynolds, formerly of Brooklyn, died after a short illness, of pneumonia, January 13th, in Smith's Falls, Ontario, Canada, where he held the position of superintendent of a large agricultural machinery works. Mr. Reynolds was born in Coventry, Conn., in 1844, and at the age of 18 enlisted in the Twenty-first Connecticut Volunteers. He served throughout the war, and after the fall of Richmond returned home and went to work in the Coventry cartridge shops. He rose to the positions of foreman and superintendent, and during the Peruvian war he was sent by the firm of W. R. Grace & Co. to Peru, to build, equip and manage a cartridge shop for the government.

After the Chilians captured Lima he escaped from the country, riding 100 miles across the mountains on a mule. Returning to Connecticut, he occupied various positions of responsibility in charge of manufacturing work. He was for three years superintendent of the Brady Manufacturing Co. in Brooklyn, N Y., which place he left to accept the position he held at his death. Mr. Reynolds was a man always popular with his subordinates, and of unswerving loyalty to the best interests of his employers.

M. W. MOREHOUSE.

The Raising of the British Ironclad "Sultan"

The ironclad ship "Sultan," of the British navy, while at torpedo practice about ten months ago, ran upon an uncharted rock in the Comino channel. The general impression in many quarters was that any attempt made to raise the ship would prove futile, and this impression even prevailed among those who had had the advantage of examining the ship as she lay submerged upon the rocks after sliding off the reef on which she at first struck. Great credit is therefore due to Messrs. Baghino & Co., an Italian firm, for performing the task successfully, which they undertook, with a risk of a heavy financial loss in the event of non-success.

The "Sultan" had sunk into a groove between two ledges of sharp-pointed rocks, these rising in separate masses six feet to eight feet high. The upper deck of the ship was just visible above the water at low tide, or when there was no movement of the sea. It became evident that, in order to raise the vessel by any means, one side of this groove which wedged her in, so to speak, must be removed by blasting the rocks, which was rendered very difficult by the formation of the rocks, and required much time and excessive labor; it is estimated that in this operation fully 500 tons of rock were removed. It was ascertained by the divers that rocks had torn no less than nine large holes in the starboard side below the bilges, the plates being seven-eighths of an inch thick, and from about fifty feet forward to about fifty feet aft the side was indented in all directions, while in some instances the longitudinals had been forced up through the double bottom; the frames, particularly the longitudinal frames, were smashed and distorted, preventing the ship from rising upon being lightened. During the time of blasting the rocks, preparations were made for stopping the leaks, so as to render it practicable to reduce the water by pumping. For stopping the leaks, much dependence was placed on a certain kind of cement, used in conjunction with wood, canvas and oakum; pieces of iron plating being worked over the larger rents, and secured to the framing by means of hooks and screw bolts, the whole being made water-tight by the application of tons of this cement, which hardened under water to the consistency of very hard putty.

As to the nature of this cement the representatives of the company are very reticent, regarding it as a trade secret. As soon as the plugging measures had been sufficiently advanced, sixteen powerful steam pumps of Messrs. Gwynne & Co.'s and Worthington's manufacture were set to work, and these ejected from the hold of the ship 5,000 tons of water per hour. The effect of so vast a discharge soon resulted in the floating of the ship sufficiently to justify an attempt to move her. The first endeavor of this kind was, however, very disappointing; the ship had scarcely been moved forward 100 feet when she sank again, the cause being the opening of one of the leaks, which, having been successfully dealt with, the power of the pumps again gave the ship buoyancy, and she was towed into Malta harbor, about thirteen miles away from the scene of the accident, and moored in Bighi Bay for the night. The next morning, after having been relieved of many tons of coal, she was put into the dock, where temporary repairs were made, to enable her to make a homeward voyage, which was successfully accomplished.

It may be said that during this voyage an average speed of seven knots was maintained. This voyage, however, was a very unpleasant one for the officers and the men, on account of the offensive smell produced by the decomposed stores and matter which had found lodgment in all the crannies of the interior. The "Sultan" was completed at Chatham in 1871. The total cost was about $1,825,200, of which $370,120 was paid for her trunk engines. The engines indicated 7,720 horse-power; her displacement is 9,200 tons; length, 325 feet; beam, 59 feet; draught, 27 feet. She carried eight 18 ton muzzle-loading guns, four 12½-ton muzzle-loading guns, and seven 4-ton breech-loading guns, besides a quick-firing armament.

The sum paid to the salvage company for recovering the ship, and placing her in dock at Malta, amounted to $243,500. Yet even with this heavy charge in addition to the large expenditure—not yet estimated—which will be required to make the hull seaworthy, the ship is too valuable to be abandoned. She is to have new triple-expansion engines developing 8,500 horse-power under forced draught, and 6,000 horse power under natural draught. The first cost of these engines will be about $399,400. The specifications of these engines were drawn up before the ship foundered, as it was thought necessary to replace the old engines.

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"The School of Experience."

As our readers are aware, the United States maintain at Annapolis a Naval Academy, at which select young men from the different States of the Union are educated in the science of seamanship and naval warfare. When graduated they are supposed to know all about navigation, as well as how to conduct offensive and defensive operations on the sea. In addition to this, those of them who can be made to absorb aristocratic notions do so, and seem to think they are made of different clay from that which enters into the composition of the common sailor, who they seem to regard as having been specially created and designed not for reasoning or thinking, but for the prompt and blind execution of orders, and for that only. The offering of a suggestion regarding matters connected with the ship by a common sailor who had never seen the Naval Academy, would, under ordinary circumstances, be a most serious offense; and yet on two occasions recently it has happened that ordinary seamen among the crews of two of our new naval vessels have not only had independent thoughts of their own, but have acted according to the dictates of their own judgment, without waiting for orders, or to ask permission. And in each case it is altogether probable that the vessel was saved by their so acting, and by that alone; and that the graduates of the Naval Academy who were in charge of the vessels, and who had been entrusted with the responsibility for their safety, owe the preservation of their lives to this independent action of common sailors, which, under ordinary circumstances, would have been met by punishment.

The first case was that of the "Idaho," which, during a cyclone in the Indian ocean, seemed to be in imminent danger of going to the bottom. The commissioned officers on board had completely lost their heads, and the captain, not knowing what else to do, had fled to his cabin, and fallen upon his knees to pray for the safety of his ship. At this point a mere boatswain, without any Naval Academy education, but with a practical experience and knowledge of seamanship, took command of the vessel; by an expedient well known to practical sailors, he brought her up to the wind, and after the danger was over resumed his place among the unthinking sailors, to be lorded over by men who, but for his knowledge of the things they were supposed to know, but were entirely ignorant of, would in all human probability have been at the bottom of the sea. The other case was that of the "Yorktown," one of the "squadron of evolution" which was recently sent across the sea, in charge of an admiral who had graduated at Annapolis, but had not been to sea for twenty years. A severe storm was encountered, and one of the small boats was being used as a drag to steady the vessel in an attempt to bring her before the wind. Orders were given from the quarter-deck to reverse the engines and turn, but in the confusion the "Yorktown" backed onto the drag, and there was imminent danger of the line, which held the drag, fouling the screw. Had this occurred, the vessel would of course have been rendered helpless, and would almost certainly have foundered. A quartermaster saw what must inevitably happen, and, seizing an axe, he severed the line, and for the next two hours, and until the imminent danger was past, practically commanded the ship.

The course of instruction at Annapolis is very thorough, and if seamen could be made by such means we feel sure they would be turned out there; but these incidents show that no amount of instruction nor education can take the place of practical experience, combined with natural aptitude and common sense. We refer to the matter because it is one of the many instances which might be quoted to sustain our position on the subject of technical education generally. We by no means condemn such education *per se*, but on the contrary think it may, and in many cases does, serve a very useful purpose; but we feel very confident that it can never be made to take the place of the training acquired by practical experience, whether its object be to make naval officers or mechanical engineers.

New York is a remarkably dirty city, in which respect it is not much different from the average American city. But there is more to this than the mere lack of cleaning streets. There is no European city of any size where the inhabitants would be allowed to make a dumping-ground of the streets to the extent they are allowed to do here. New York is often contrasted with Paris in the way of the cleanliness of streets. To be sure there is a good deal of labor expended in keeping the streets of Paris clean, but, after all, one of the principal reasons why they are so clean is because no one is allowed to litter them. Nothing, not so much as a piece of paper, can be thrown on the streets there without the probability of arrest by the police. So long as the throwing of almost any kind of garbage on the streets is permitted, as it is in America, and so long as the tipping over of garbage barrels and the scattering of their contents is recognized as a national amusement, it will never be possible to keep the streets as clean here as they are kept in Europe. Periodical outbursts of street cleaning, it stands to reason, cannot accomplish the purpose. What is wanted is not spasmodic efforts of this kind, but a regular, persistent effort, that prevents the streets from becoming dirty. It is the case of the ounce of prevention instead of the pound of cure, which is no cure at all.

The deadly car stove has once more got in its murderous work; this time on the Cincinnati, Hamilton & Dayton road, near Cincinnati. A vestibuled express train ran into the rear of a local passenger train, and crushed several cars, which immediately took fire from the stoves, and all those passengers who were not able to help themselves out at once, or were not immediately rescued by others, were roasted to death.

It so happens that the legislatures of the various States are usually in session at the time of year when the car stove is in use, and from this circumstance some hope may be derived, that eventually it will be legislated out of existence. But it is sad to think that in all probability a wholesale burning of human beings must occur in a majority of the States, before public opinion will be sufficiently aroused to banish the stove entirely.

The text of a bill, now before the New York legislature, provides that all workmen shall be paid weekly. No "store orders" will be valid as an offset against the employes' wages.

This is a good bill, and it will probably work very well in the State of New York, where the "pluck me" stores have not, for some years, had much sway. But there are, unfortunately, States in which these laws against such stores amount to practicallly nothing. However, it will be something of a triumph if the law is passed and prevails universally in one State.

A great deal of English capital has been invested in business in this country recently—not less, it is estimated, than $200,000,000. This money does not, as is generally supposed, all come from the moneyed class of England. A large part of it comes from investment companies who are handling the funds of small investors to the best advantage. There is hardly anything like this in this country. The poor investor here would stand a good chance to lose what he invested in an "investment company."

The story is that the Bland silver dollar is being systematically counterfeited in Mexico, and sent to this country. There is a good profit in this, as the American dollar is nearly thirty cents short in value. The story may not be true, but the way to stop the possibility of such work is for the United States to return to the ways of honesty, and give 100 cents for a dollar.

Mr. Walter Gribben has had printed on cardboard, the table of compound index movements published in our issue of Jan. 16, and kindly offers to send a copy to any one who will send his address, enclosing stamp for postage. Mr. Gribben's address is 1004 9th street, N. W., Washington, D. C.

QUESTIONS AND ANSWERS

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(35) J. M., Hartford, Conn., writes: Please advise me as to any instrument for ascertaining the horse-power which any machine is exerting; for instance, the power of a lathe. *A.*—A dynamometer of suitable form is used for the purpose, and from its readings the horse-power is calculated. The attachment of a dynamometer to a lathe is shown in the AMERICAN MACHINIST, September 11, 1886.

(36) P. T. O., ———, asks: What weight should a bearing 4¼x8 inches carry in order to avoid heating by friction, running at 40 miles an hour? Size of wheel 42 inches diameter. *A.*—For this high rate of speed we should not allow more than 150 pounds per square inch of projected area of the journal, making the total weight equal to $150 \times 4\frac{1}{4} \times 8 = 5{,}100$ pounds. 2. At what speed could a train be safely run with the same size of wheel, when carrying 10,350 pounds on a 4¼"x8" bearing? *A.*—About ten miles per hour. For a local train this speed may be somewhat exceeded.

(37) W. S., Philadelphia, Pa., writes: Several persons, myself included, have had an argument about the respective merits of steel and iron for the construction of marine boilers; some of us prefer steel, while others favor iron. Please give your opinion of which is the better metal, and why you would prefer it. *A.*—We prefer steel, because, when it is properly manipulated, we believe it to be a stronger material, and safer to use for boilers, than iron. Also in ordering steel plates we have a greater assurance of obtaining perfect and homogeneous plates than when ordering iron sheets. For any given pressure, steel boilers can be made lighter than iron ones, which is an important consideration in marine engineering.

(38) A. T. S., ———, Ill., asks: Is the air chamber on the suction pipe of a steam fire pump properly called an "air chamber," or should it be called a vacuum chamber? State fully the action of the air, water, or the vacuum in it. *A.*—When the pump is working there is not a vacuum in the chamber, and therefore it cannot be called a vacuum chamber; "air chamber" is the proper name for it. The air in it acts as a cushion against which the water acts, and prevents, to a great extent, the pump from pounding. 2 Is the pressure at the bottom of a boiler greater than it is at the top? *A.*—The steam pressure is the same on all parts of the boiler, but the bottom has to support the weight of the water, hence it may be said that pressure at the bottom is a little greater than at the top.

(39) ———, Athol, Mass., writes: Please inform me how to make a solution for covering glass to make it reflect like a mirror, and how it is applied to the glass. *A.*—Mix 90 parts, by measure, of a solution of Rochelle salts at 1 50 specific gravity, with 900 parts distilled water, and boil them in a flask; drop in carefully 20 parts of a solution of nitrate of silver, specific gravity 1.18, and boil again. This solution can be bottled and kept for any length of time. Another fluid has to be prepared by adding ammonia to a solution of nitrate of silver, until the precipitate is entirely dissolved; filtering and diluting one part of it with 100 parts of water. For use, put equal parts of the two preparations in a suitable vessel, clean the glass well, and immerse it in the mixture until sufficiently coated. The coating of silver should be protected with a coat of varnish.

(40) A. M., Dresden, Ont., writes: I have a cast iron box about 1½ inches wide, 3 inches deep and 9 inches long. I wish to melt lead in it to draw the temper in wood-working knives. Now will you give me some information regarding this process, also number of degrees required for each color? *A.*—Lead is not usually employed for drawing temper, but for heating to harden, the temper being afterwards drawn by other means, such as oil, or by holding over a fire. The degree of heat required for such cutters will be about 490° if they are not to be filed, and 570° if they are. Thermometers for measuring such temperatures can be obtained of the makers of scientific apparatus, and will cost about $3.00. Lead melts at about 620°, so that, when melted, it would already be hotter than the temperature desired. By using oil, and covering it over to exclude the air, the desired temperature can be reached, but it will blaze up as soon as air comes in contact with it. The articles to be tempered can be put into a perforated iron vessel, having a handle by which it can be carried. This can be submerged in the oil, which is in another iron vessel having a cover, through a hole in which

the thermometer can be passed. This is placed over a fire, and the heat slowly raised to the desired point, when the cover is removed, the inner vessel lifted up, and its contents dumped into sawdust or water.

(41) L. A. J., New York, asks: What distinct changes occur in the low-pressure cylinder of a vertical triple expansion condensing engine when the high-pressure crank is on a dead center, pointing towards the cylinder head? *A.*—If the cranks are set equal distances apart, no distinct changes will occur in the low-pressure cylinder in the given position. The lower steam ports in this cylinder will be wide open to the steam, and the upper steam ports will be wide open to the exhaust. Under these conditions the lower face of the piston will be subjected to the full initial pressure, and the upper face of the piston will move against the back pressure, which, in a condensing engine, will probably not exceed an absolute pressure of three or four pounds per square inch. It is possible, but not probable, that the valve may have such an excessive lap as to cut off steam in the low-pressure cylinder at the time the high-pressure crank is in the given position. Under these conditions the change which occurs in the cylinder is that expansion of the steam commences.

(42) W. H. C., Portland, Me., writes: I have an upright tubular boiler, steel, 24 inches high and 20 inches diameter, length of tubes 12 inches, the remaining 12 inches being the depth of the fire-box less the thickness of the grate. There is no water-leg, but a piece of heavy iron is bent to conform to the shape of fire-box, and of such diameter as to allow about one-half inch of air space between it and the shell. I use this boiler for amusement, but I wish to enlarge it by adding another 12 inches to the length of fire-box; would you advise using the same shell? *A.*—If the shell is in good condition, use it. The boiler is a poor one, and will not be much improved by making the change. 2. Do you consider the heat from the fire-box, in a boiler of this type, will ultimately weaken the shell? *A.*—If the whole length of fire-box is well lined with fire-clay or brick, it will last for a long time, otherwise there is danger of burning the fire-box sheet. 3. I have in my mind a spiral tube boiler for amateur work, but I have been told that the circulation would be so violent in such a boiler as to make it undesirable. What is your opinion on the subject? *A.*—If you do not drive the boiler too hard, the circulation should not give you any trouble. We do not consider it to be the best kind of boiler for amateur work. 4. Please give me the name of some good book treating on the care and management of stationary engines and boilers. I am familiar with the subject in a general way, and do not wish an elementary work, but something plain and practical. *A.*—The Catechism of the Steam Engine, by John Bourne, may give you the information sought.

(43) Reader, Englewood, Ill., sends us a sketch of a crane, and writes: I have a five horse-power engine which would be very handy to use, if it will lift the load, as it is in every other respect suitable for the purpose. I am not quite sure if I can rely upon my calculations, as I have had very little experience with friction and worm gearing. Please show thoroughly how the calculations are to be made, and give your opinion of the crane. The load to be raised is ten tons *A.*—In the first place, the pulleys for hoisting are arranged for raising the weight one-half of a foot for every foot of rope taken up by the drum. The drum is 30 inches diameter, its circumference is 94.24 inches; therefore during one revolution of the drum the load will be raised $\frac{94.24}{2} = 47.12$ inches. On the drum shaft there is a worm wheel with 100 teeth, engaging with a worm, consequently, while the drum is making one revolution the worm must make 100 turns. On the end of the worm shaft there is a friction wheel 24 inches diameter, engaging with a friction wheel 14 inches diameter on the crank-shaft. Now, since the worm makes 100 turns, the large friction wheel must also make 100 turns, and the small friction wheel, or, in other words, the crank-shaft, must make $\frac{24 \times 100}{14} = 171.42$ turns. If now the stroke is 10 inches, the piston will travel through a distance of $171.42 \times 10 \times 2 = 3,428.4$ inches during the time the weight is raised 47.12 inches The friction between worm and wheel is very great, making the total amount of the friction of the crane equal to about 75 per cent. of the pressure on the piston, which will be equivalent to raising a weight of 40 tons without friction, instead of 10 tons with friction. At 2,000 pounds per ton we have to lift 80,000 pounds, and the work performed will be equal to $80,000 \times 47.12 = 3,769,600$ inch pounds. In order to perform this work, the total pressure on the piston will have to be equal to the quotient obtained by dividing this work by the corresponding piston speed; hence we have

$$\frac{3,769,600}{3,428.4} = 1,099 \text{ pounds.}$$

Assuming the mean effective pressure on the piston to be 60 pounds per square inch, we have

$$\frac{1,099}{60} = 18.3 \text{ square inches,}$$

and the corresponding diameter will be 4⅞ inches nearly, say 5 inches; hence you will require a 5″x10″ engine, with a mean effective pressure of 60 pounds. It is difficult to express an opinion of your crane from the rough sketch you have sent us, and the meager data furnished; the size of engine even is not given. We do not like the idea of friction wheels for the purpose you intend to use them.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue.

Gear wheels and g-cutting. Grant, see adv., p 16.

Link-Belting and Sprocket Wheels.

Send for Catalogue of Link-Belting.

Over 50,000,000 feet of Link-Belt in use.

Link-Belt Engineering Co , Philadelphia and N.Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc., J. B. Roney, Lynn, Mass.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

The best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.

R. Dudgeon, 24 Columbia st , New York, Improved Hydraulic Jacks and Roller Tube Expanders.

The Improved Justice Hammer. Williams, White & Co., Moline, Ill., manufacturers.

Pattern and Brand Letters. Vanderburgh, Wells, & Co., cor. Fulton and Dutch sts., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st , N.Y.

Ice and Refrigerating Machines, 140 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

S. W. Card & Co., Mansfield, Mass., carry a full line of Stay Bolt and Patch Bolt Taps.

Castings for small and medium sized vertical engines. Humphrey's Foundry, Bellefontaine, Ohio.

Adjustable Shrinkage Gauges. Pedrick & Ayer, Philadelphia, Pa.

Link Milling and Slotting Machine. Pedrick & Ayer, Philadelphia, Pa.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

For best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N.Y. Send for des'n.

For the latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Patent Attorney. R. G. DuBois, 715 11th st., Washington, D. C., procures first-class patents on inventions. Valuable Hand-book on patents free.

The Sure Grip Steel Tackle Blocks must fill the bill, according to the large sales reported. See advertisement, page 13.

25″ 28″ 32″ 36″ Upright Drills a specialty. Finely made, great capacity, quickly operated, prices low. Send for list of firms using our Drills. J. E. Snyder, Worcester, Mass.

25″ 32″ 37″ 42″ "Only Drill Press built on 'Ko-rekt' principles, even if they come from Jersey." Gould & Eberhardt, New Ark, N. J.

Standard Reducing Valve, Standard Pump Pressure Regulators, Improved Collignon Cylinder Oil Pumps, Jenkins Globe and Angle Valves. Send for circulars. Standard Regulator Co., Buffalo, N. Y.

Patents.—Patent soliciting of high class. D. Walter Brown, 31 Nassau st., New York.

Send for "A Brief History of Patent Legislation in the United States."

Every draftsman needs one. The Engineer's Sketch Book of mechanical movements, appliances, devices, contrivances, etc., by T. W. Barber. 1,936 illustrations 8vo. cloth, $3. Catalogue of books on mech. subjects free. E. & F. N. Spon, 12 Cortlandt st., New York.

Superintendents of industrial establishments will find the *Engineering and Building Record*, published weekly at 277 Pearl st., New York, useful. Municipal and building engineering problems a prominent feature. Specimen copy, 10 cents.

De Lamater Screw Propeller Wheel made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

Stub Ends and Connecting Rods for small connections. Especially adapted for Valve Rod for Steam Engines. T. C. Dill Machine Co., Philadelphia, Pa.

H. B Roelker, 22 Cortlandt st., New York, late Sup't De Lamater Iron Works, will hereafter manufacture the De Lamater Screw Propeller. Propellers of same pattern and workmanship as formerly made by the De Lamater Iron Works. Each designed for its special work at lowest prices. Consulting Expert and Constructing Engineer. Estimates made on machinery and on damages.

Just concluded. "Practical Drawing." By J. G. A. Meyer. Copies of the American Machinist containing the above series of 93 articles sent by mail to any address in the U. S., Canada or Mexico, for $4 65, or single copies 5 cents each. American Machinist Publishing Co. 96 Fulton st., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the American Machinist. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 96 Fulton st., New York.

Just concluded. "Modern Locomotive Construction." By J. G. A Meyer. The above series of 106 articles, which have attracted so much attention everywhere, is now concluded in newspaper form. Copies of the American Machinist containing the entire set sent by mail to any address in the U. S., Canada or Mexico for $5.30, or single copies 5 cents each. American Machinist Publishing Co., 96 Fulton st., New York.

C. H. De Lamater & Co. have closed their extensive manufactory at the foot of West 13th street, New York, and have sold the Hot Air Pumping Engine and Steam Pump business to the De Lamater Iron Works (incorporated in 1889), and the Propeller Wheel business to the Samuel L. Moore & Sons Co., of Elizabethport, New Jersey.

In order to close out the remainder of the stock, offer for sale a very desirable lot of machinery, such as lathes from 15″ to 88″ swing, planing machines 48″x45″x10′, 53″x50″x12′, 17″x14″x24′, 72″x69″x24′, and various other sizes; drilling machines, slotting machines, shaping machines, boring machines, bolt-cutting machines, cutting-off machines, nut tappers, milling machines, gear cutters, emery tool grinders, portable drills, screw-cutting machines, vises, lathe and planer tools, and a variety of small tools; also traveling and jib cranes.

Punching and shearing machines for boiler makers, with a general outfit of small tools. Blacksmiths' tools, such as anvils, sledges, tongs, etc. Pattern lathes, benches, saws, screws, nails, and a general supply of small tools Foundry cranes, cupolas and small tools. Blocks, ropes, bolts, nuts, washers, packings, pipe and fittings, iron and brass valves. Boiler iron, steel plate and boiler rivets. Bar iron and steel, also steam hammers and two 8″x16″ and one 10″x30″ Rider cut-off engines.

MANUFACTURES

It is proposed to build a thread mill in Greenville, N. J.

A shoe factory, 26x60 feet, is building at Somerset, Mass.

The Roanoke Machine Works, Roanoke, Va., will be enlarged.

The Hot Springs (Ark.) Railroad Company will build a roundhouse at Malvern.

The Rapidan (Minn.) Water and Electric Co. has been incorporated; also the Rapidan Milling Co.

Thomas Driver proposes to buid a harvester factory at Livermore, Cal., if given a site and $3,000 in cash.

The Wise Wagon Works have been incorporated at Buena Vista, Va. The capital stock is to be not less than $10,000 nor more than $100,000.

New York parties have offered to take $48,000 of the stock for an $80,000 paper mill company at Dallas, Tex., if the remainder is subscribed there.

A charter was recently granted to the Valley Construction Company, at Pittsburgh, Pa., for the manufacture and dealing in boilers, engines, structural iron and steel.

The Braintree Street Railway Co., of Braintree, Mass., has been organized, with a capital of $25,000 divided into 250 shares at $100. The road will be operated by electricity.

A company has been formed in New Orleans, La., with a capital of $150,000, for the manufacture of sulphuric, muriatic and nitric acids. It will be controlled by the Standard Guano Co., of the same place.

There is water-works agitation at Norfolk, Va.; Gonzales, Tex.; North Knoxville, Tenn.; Romeo, Mich.; Cheney, Wash.; Babylon, N. Y.; Wichita Falls, Tex.; Goldendale, Wash.; Los Angeles, Cal.; Trenton, Tenn.

The Car Track Supply Company, of Chicago, has been incorporated by W. T. Burling, J. H. Campbell and William Taylor, for the purpose of manufacturing the Hubbard self-oiling car journals. The capital stock is $200,000.

The Rollstone Machine Co., formerly of Fitchburg, Mass., are moving to Anniston, Ala., under management, as formerly, of Geo. L. Stearns. They have purchased their outfit of tools of the Lodge & Davis Machine Tool Co., New York.

The Peoria Metal Spinning Company, of Peoria, Ill., has been incorporated, with a capital stock of $50,000, by C. W. Robinson, J. C. Babb and J. H. Bevington. The company proposes to deal in railway signals, and stamp and die drawings of metals.

The Thomas Manufacturing Co. has been incorporated at Little Rock, Ark., by D. H. Thomas, manufacturer of cotton presses; A. D. Thomas and B. L. Williamson, to conduct a general foundry and machine works business. The capital stock is $100,000.

The Shellenback pulley lathe, which has been heretofore built by the Richmond City Mill Works, at Richmond, Ind., is to be built by M. C. Henley, of Richmond, Mr. Shellenback acting as superintendent. The lathes will be sold by the Lodge & Davis Machine Tool Co.

The American Car Door Company is the name of a new corporation formed in Indianapolis, Ind., for the purpose of manufacturing appliances for railroad cars and house doors. The capital stock is $100,000, and the directors, Jacob L. Wagner, Charles S. Lewis and N. L. Travers.

The Clay Shingle Company, Indianapolis, Ind., has been incorporated by Jno. R. Elder, H. C. Long, and J. E. Donaldson. Capital stock, $100,000. They will at once enlarge the works now in operation at Montezuma, Ind., and put their clay shingle, which is said to be an excellent roofing material, on the market.

The firm of James Leffel & Co., Springfield, Ohio, manufacturers of water-wheels and engines, is to be reorganized under a new name, and it is stated that Mr. Fuller Trump, who for some years has been general manager of the works, will retire, and, with others, form a new company, which will manufacture water-wheels in the same city.

A company has recently been organized at Montreal, with headquarters at Three Rivers, for manufacturing on an extensive scale cast-iron water and gas pipes, and general supplies in this particular line. They expect to be in full operation early next spring, as the buildings are now about completed. The officers elected of the Canadian company are M. Schwob, vice-consul of France, Montreal, president; E. Samuel, of Toronto, vice-president; C. H. A. Grant, secretary-treasurer; Ludovic Delavalle Poussin, C. E., managing director.

A syndicate of capitalists, of which H. W. Hartman is a member, has purchased 600 acres of ground at the intersection of the Pittsburgh & Western Railroad and Conoquenessing creek, Pa., and will locate thereon a number of manufacturing plants. Several dams will be thrown across the stream, and the natural resources developed. A 6-foot vein of coal, and a 20-foot vein of limestone underlie the tract.

The farmers in the Saddle River Valley, in Bergen County, N. J., are rejoicing over the prospect of having a railroad run through the valley. Heretofore all produce had to be carried in wagons over rough country roads in North Hudson before reaching the New York market. Several residents of Arcola and Rochelle Park have succeeded in interesting the West Shore Railroad officials in the scheme, and it is probable a branch railroad will be built.

A deposit of ozokerite, covering about 5,000 acres, has been discovered in Utah. This is said to be the second deposit ever found, the other being discovered at Borelan, in Galicia, Austro-Poland. The latter covers a tract of 800 acres. Ozokerite is a black, wax-like substance, which, being refined by paraffine, produces celusin, which, in addition to being valuable in the manufacture of rubber goods and fine candles, is one of the best insulating materials known. The Utah deposit has been purchased by New York capital.

A certificate of the incorporation of the Leslie Brothers' Steam Snow Plow Company has been filed in the county clerk's office, of Paterson, N. J. The company intend to manufacture steam snow plows, locomotives and general railroad appliances. The works will be located in Paterson, N. J. John P. Leslie and Edward Leslie are the principal stockholders, each having 2,250 shares. Mathew Sweetman, of Toronto, Canada, holds 500 shares. The company is composed of the three persons named, and begins operations with a cash capital of $500,000.

The East River Railroad Company has been incorporated, with a capital of $1,000,000, to build, through the Henning Gravity Tunnel Company, a tunnel under the East river, from the foot of Broome street to a point near the foot of Broadway, Brooklyn. Benjamin S. Henning is president, and George S. Morrison consulting engineer. The tunnel is to be between two thousand and three thousand feet long, and is to be built on an incline of about fifteen degrees from each end toward the middle. A gravity railroad is to be run, with a grip cable to aid in bringing the cars to the top of the incline.

A meeting has been held at Manchester, N. H., of the various electric light and power companies of the State, for the purpose of forming a State association. Nearly $600,000, or about three-fourths of the total amount invested in these industries in New Hampshire, was represented. The association organized by choosing Alonzo Elliott, of Manchester, president; F. W. Esterbrook, Nashua, vice-president; I. H. Woodman, Concord, secretary and treasurer; Alonzo Elliott, F. W. Esterbrook and H. W. Burgett, Dover, executive committee. Headquarters of the new association will be in Manchester.

The Niles Tool Works, Hamilton, Ohio, write us We did the largest business in our history in 1889 and we confidently expect to increase this very considerably during the present year. We are arranging matters with that in view. During 1889 we added extensively to our facilities, both in the way of buildings and tools. We have just completed an addition to the machine shop, 50x200 feet, which will be in operation before the end of this month. We have under way a 300-feet addition to the foundry. In this addition we will use two overhead traveling cranes, 20 tons capacity each. We also have, in another wing of our foundry, two 15-ton overhead cranes. We last year added an addition to the foundry, 55 feet and 150 feet. We have put in a coupled compound condensing Corliss engine, cylinders 16″ and 30″ diameter, and 48″ stroke; also another battery of boilers. We also have plans made for another addition to the machine shop, 100 feet wide by 400 feet long; one section of this, 50x400 feet, will be an addition to the erecting shop, and will be covered by two overhead traveling cranes of 25 tons capacity each. This will be built in the spring. We have been running during the latter part of last year about 800 men, and, with the additional room we are providing, we expect to increase our force to about 1,200. We have turned out during the past year some of the largest work we have ever done. Among other work done there has been about 20 boring mills, from 14 feet to 20 feet swing, weighing from 60 to 80 tons each; also quite a number of large planers, 7 feet, 8 feet and 10 feet square. Also some very heavy sets of bending rolls, for boiler and ship plate. We have just completed a set of 22-foot rolls for the Mare Island Navy Yard, which is unquestionably the heaviest machine of its kind in this country. It weighs, complete, 250 tons, and is capable of bending 1½″ plate 22 feet long. This machine is to be used for armor plate. Prices of some classes of material, such as large forgings, have advanced rapidly, and the prices of tools have necessarily advanced to keep pace with same.

Machinists' Supplies and Iron.

NEW YORK, Jan. 25, 1890.

Iron — American Pig. — The demand continues moderate, and no transactions of importance have taken place. The prevailing dullness has begun to have its effect on prices, which, it is believed, are often shaded somewhat. We quote standard Lehigh brands, No. 1 Foundry, $20 to $20.50; No. 2, $19 to $19.50. Grey Forge, $18.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Wanted—Good machinists, and one or two pattern makers. The Pond Mach. Tool Co., Plainfield, N. J.

Mechanical draftsman wants situation. L. N., AMERICAN MACHINIST.

Foundry foreman, 25 years' experience, is open for engagement. Address "Iron," AMERICAN MACHINIST.

Wanted Exp'd mechanical draftsmen. State ability and salary. Balto. Sug. Ref. Co. South Baltimore, A. A. Co., Md.

Foreman and contractor wanted, who can handle men and do good work promptly. Address Steam Engine, care AMERICAN MACHINIST.

A mechanical draftsman is open for engagement. Thoroughly competent in machine and engine designing Shop. exp. Box 74, AMERICAN MACHINIST.

Wanted — Draftsman. Experienced, practical, mechanical draftsman wants position. Address Draftsman, P. O Box 521, Baltimore, Md.

Wanted—Three or four exp'd mech. draftsmen. Address Mechanical Engineer, P. R. R., Altoona, Pa., stating experience, also salary required.

Mechanical engineer, technical graduate, desires position as assistant sup't or draftsman. Have had charge of help. Address Box 77, AM. MACHINIST.

Wanted Competent tool maker to take charge of tool-room. Address, giving ref., and salary expected Valk & Murdoch Iron Works, Charleston, S. C.

A young man with 5 years' experience on pattern work would like position as draftsman. Address C. A. Smith, Box 304, Exeter, N. H.

Salesman—One who is capable, energetic and active, for city trade. Apply, to Charles A. Schieren & Co., 47 Ferry St., N. Y.

Wanted—A young mechanical draftsman, experienced in machine tool designs, and capable of photographing machinery in-doors. Address Steady position, AMERICAN MACHINIST.

Machinists Wanted—First-class vise and machine hands of good habits, can find steady employment and liberal wages Address Morgan Engineering Company, Alliance, Ohio.

Wanted—A reliable, competent man, exp'd in office work and correspondence, familiar with engines, boilers and appliances. Apply by letter, giving refs. and salary required, to W., AM. MACHINIST.

Wanted—Experienced draftsman on hoisting and mining machinery Good wages and permanent situation. State age, experience, and salary desired. Address "Pitts," AMERICAN MACHINIST.

Wanted—Position as draftsman on steam engine work. Technical education in Europe, and some experience in drawing office in U. S. Salary small only. Address "Calculator," care AM. MACHINIST

A thorough machinist and good draftsman, having had sole responsibilities of shop's management for years, exceptional references, open for engagement. Address F. J. Parish, 479 W. 22d st., N. Y. City.

Wanted—A good pattern maker. A young man with experience in mechanical drawing preferred. Address, giving age, experience and wages expected, The Fox Machine Co., Grand Rapids, Mich.

Wanted—A first-class mechanical draftsman, familiar with modern blast furnace work. Must be able to come on at once. Address, with full particulars, West Superior Iron and Steel Company, West Superior, Wis.

Wanted—A draftsman to take charge, later on, of drawing room. Must be under 35 years of age, and capable of adapting himself to conditions. Later advancement if satisfactory. Preferable, one who has worked 3 or 4 years in machine shop, and who has studied technical branches. State age, exp., refs. and wages expected. P. O. B. 1044, Providence, R. I.

Salesmen can add to their incomes by selling our goods on commission. Commissions to one salesman, who devoted only one hour daily to our goods, averaged twenty-five dollars per month for the past three months. Our goods have been on the market for twenty one years, are well known, and are first-class in every respect. Address Box 72, AMERICAN MACHINIST.

MISCELLANEOUS WANTS

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Cheap 2d h'd Lathes & Drills. S. M. York, Cleve., O.

Koopman's Scales for quick measurements.

Just out; aluminum-steel hack-saws, hard but not brittle. Crescent Mfg. Co., Cleveland, Ohio.

New catalogue of engineers' specialties free. Crescent Mfg. Co., Cleveland, O.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Turned and Highly Polished Iron and Steel Shafting a specialty. Merwin McKaig, Cumberland, Md

Complete list of our Scales and other new tools for 2c. stamp. A. T. Koopman, Chicago.

Foundry desiring to add a paying specialty with well establ'd trade, address Box 192, Honesdale, Pa.

Engineers wanted to send their addresses and receive free a 25 cent book, "Hints and Suggestions for Steam Users." Lord & Co., P. O Box 1262, Phila., Pa.

For Sale—An established mach. business, protected by valuable patents. Can be much enlarged by judicious management. C. M. W., AM. MACHINIST.

Wanted—Machines for winding, sewing and trimming brooms. Latest improved, for power. W. W. Butts, Guilford Centre, N. Y.,

Simonsen-Walter Mfg. Co., Jefferson City, Mo., with modern foundry, machine and wood-work plant, wants spec. to manuf. for Western trade.

Wanted—In a well-equipped machine shop, some light machinery to build; also light jobbing and model making. Correspondence solicited. Address A. H. Anthony, Jewett City, Conn.

Wanted—To buy second-hand lathes, planers and shapers of all sizes; must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati, O.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

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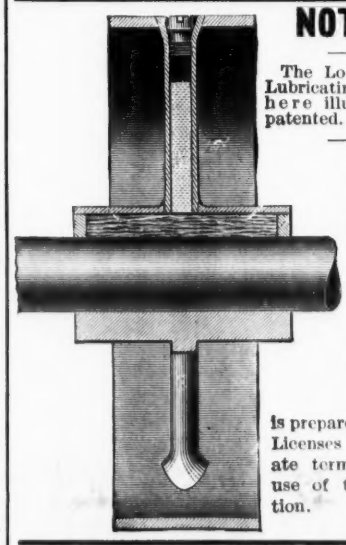

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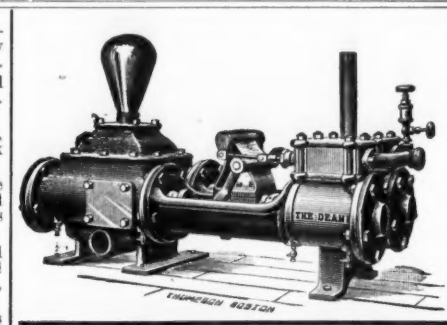

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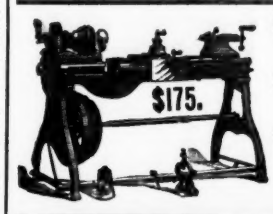

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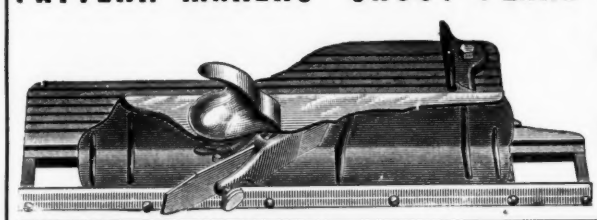

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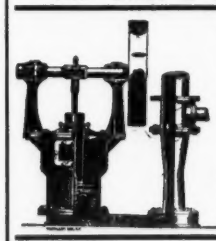

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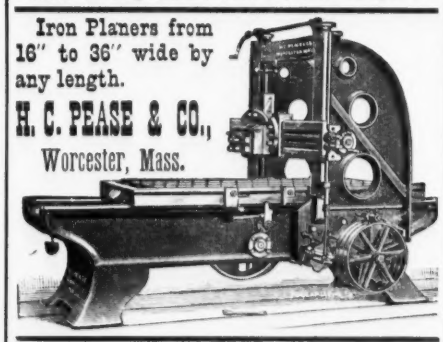

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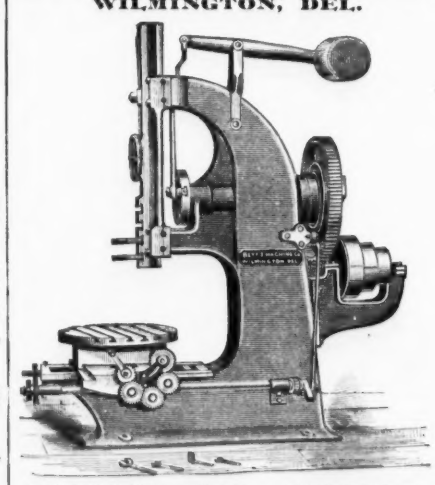

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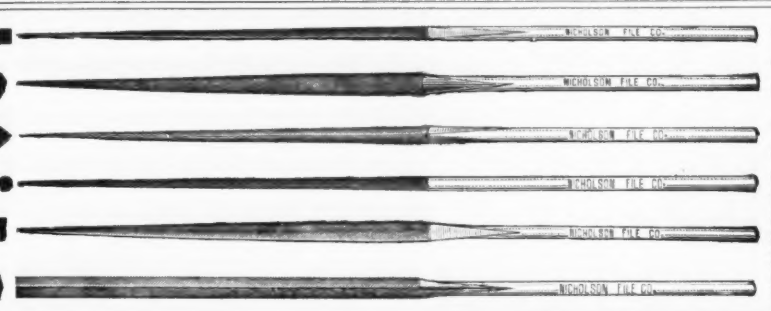

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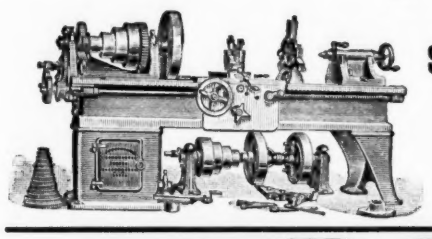

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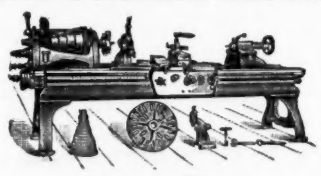

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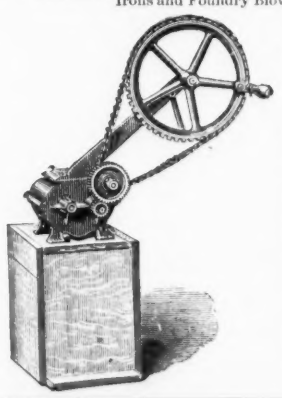

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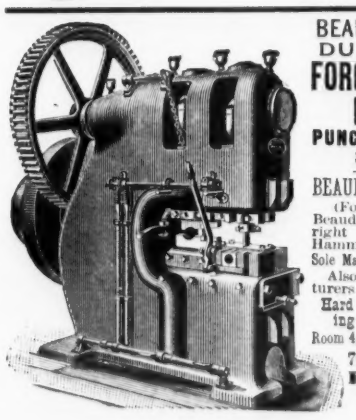

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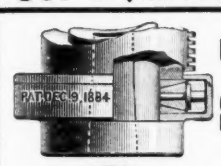

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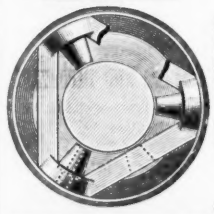

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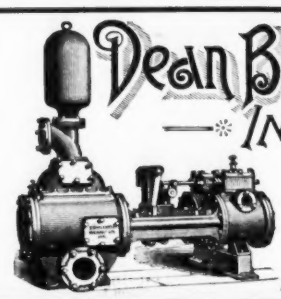

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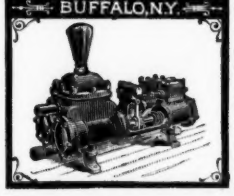

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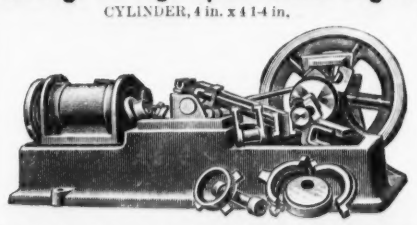

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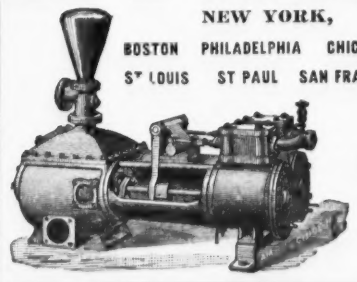

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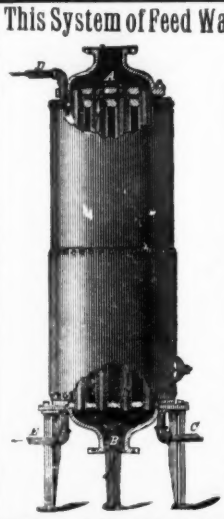

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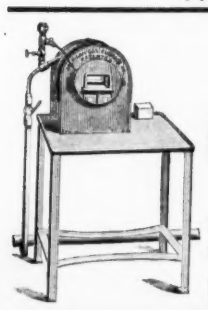

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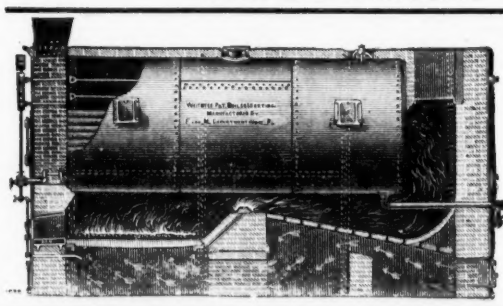

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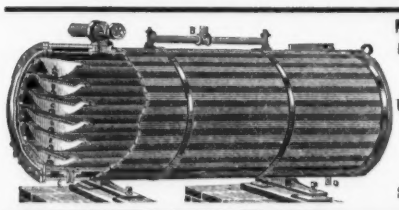

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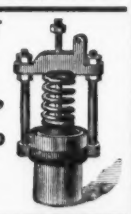

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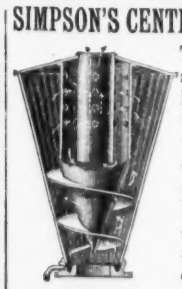

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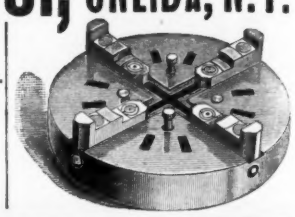

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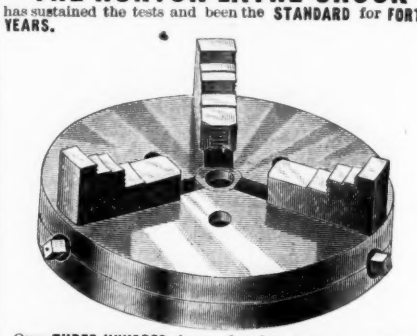

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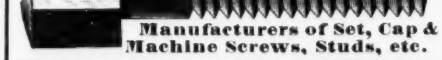

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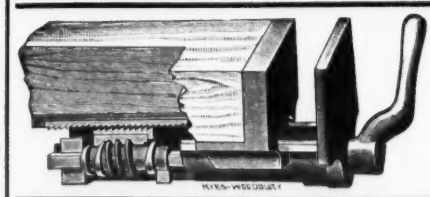

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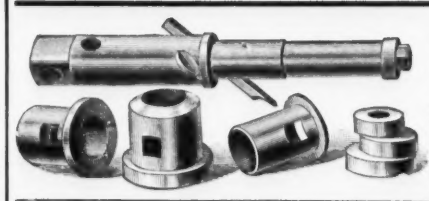

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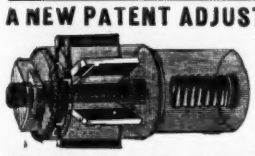

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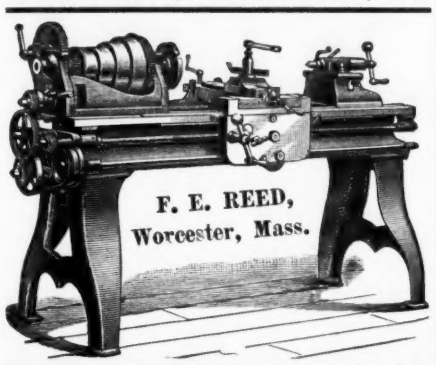

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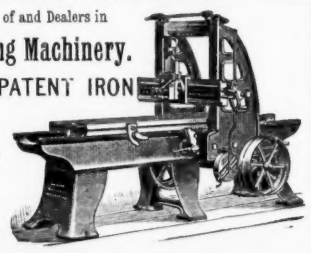

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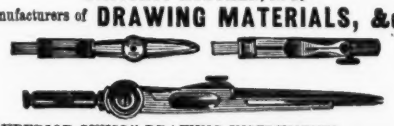

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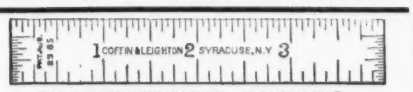

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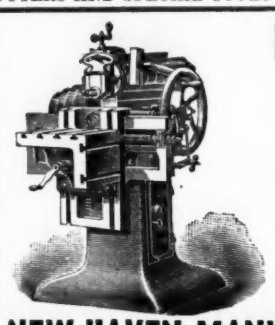

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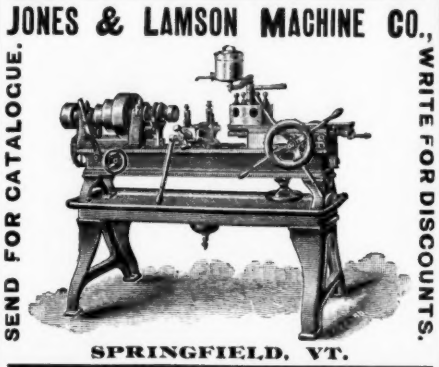

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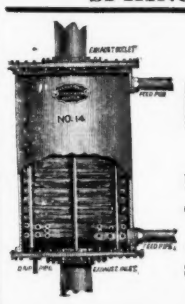

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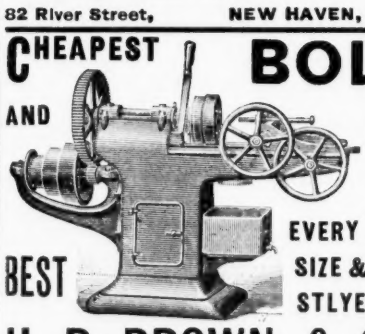

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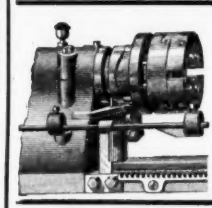

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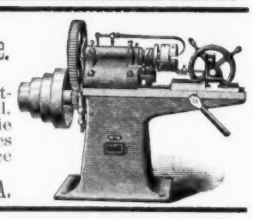

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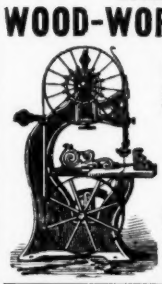

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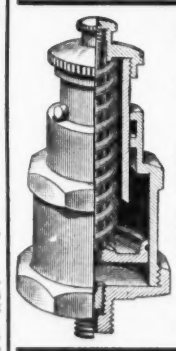

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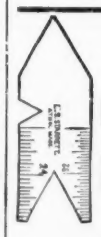

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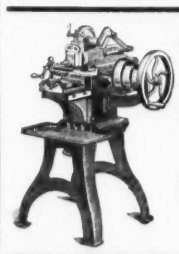

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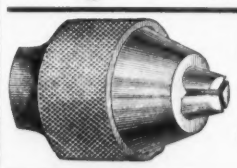

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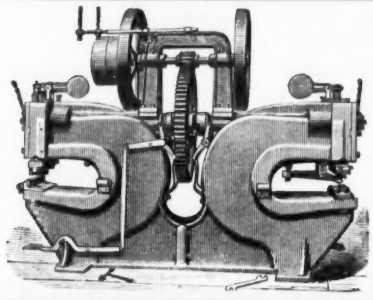

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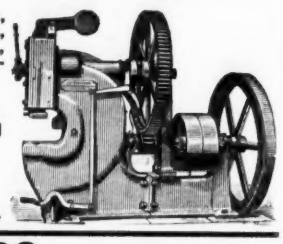

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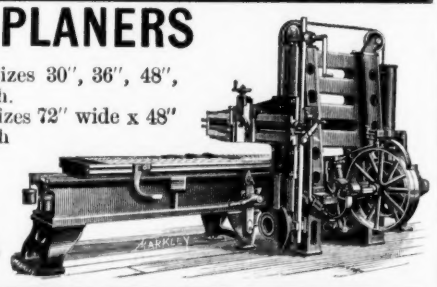

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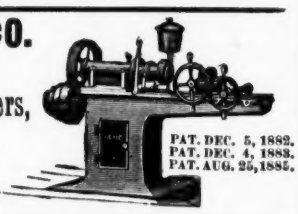

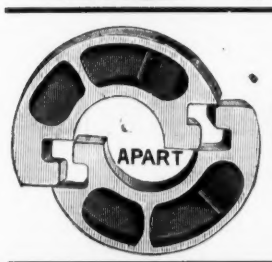

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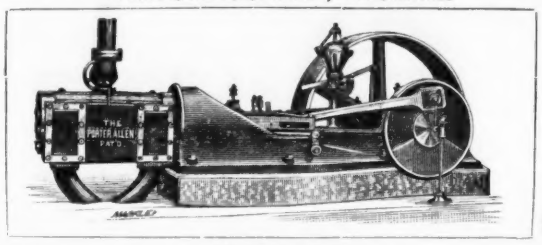

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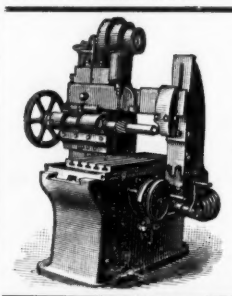

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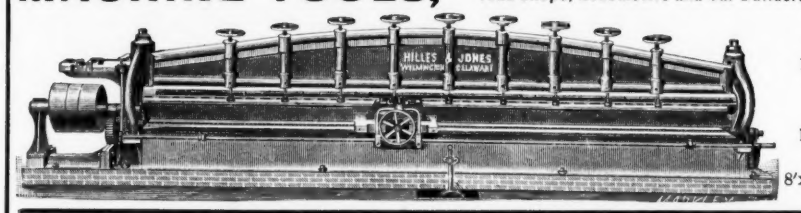

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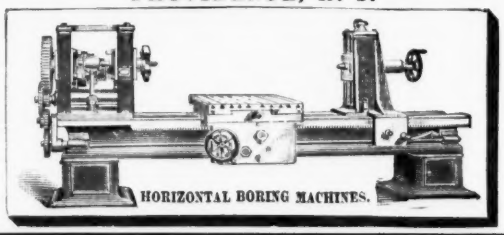

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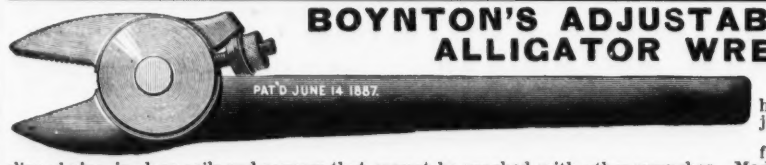

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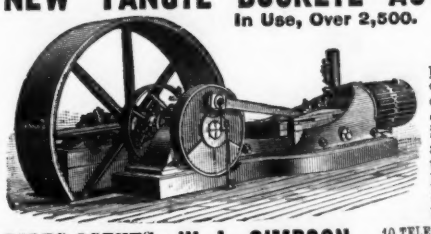

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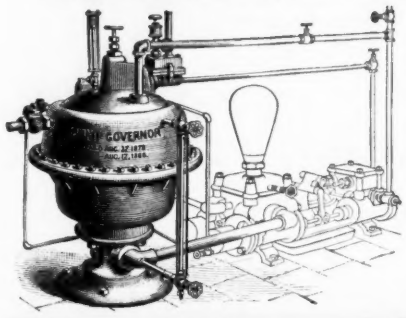

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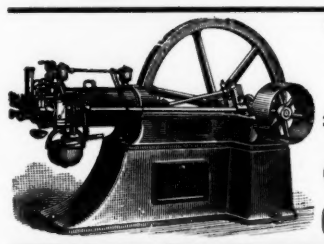

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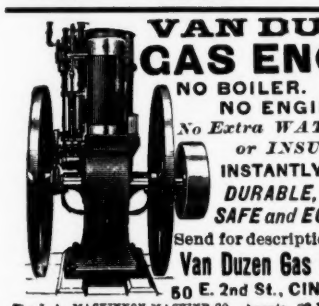

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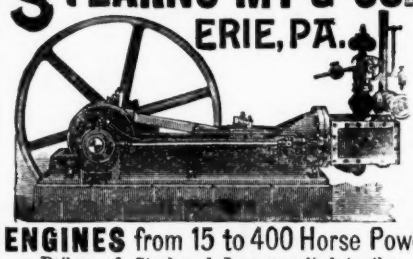

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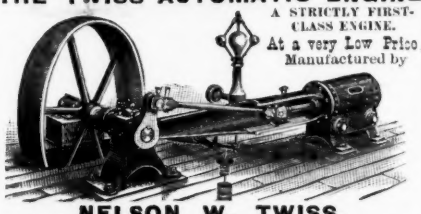

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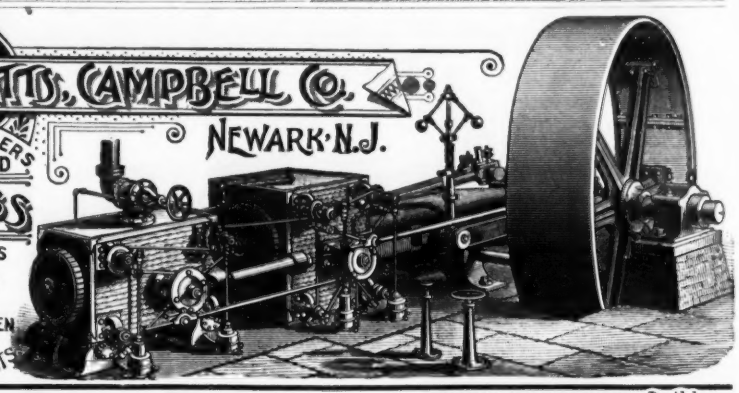

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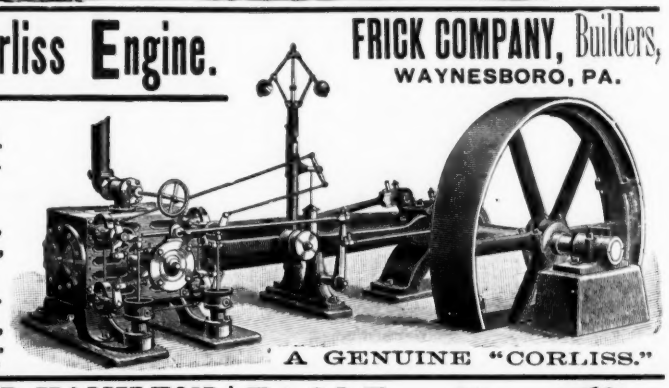

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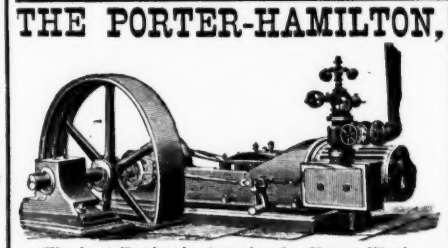

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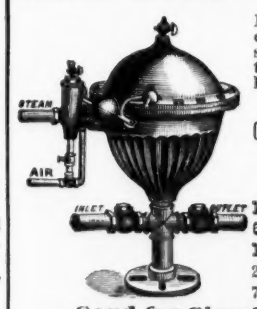

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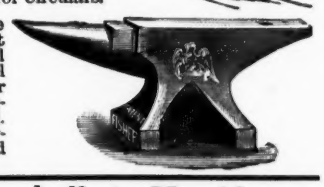

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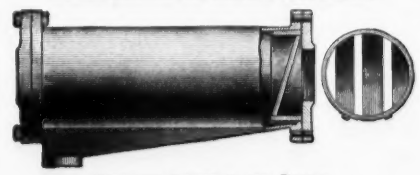

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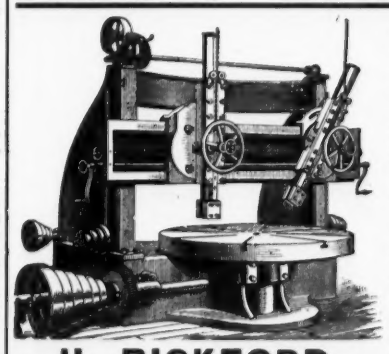

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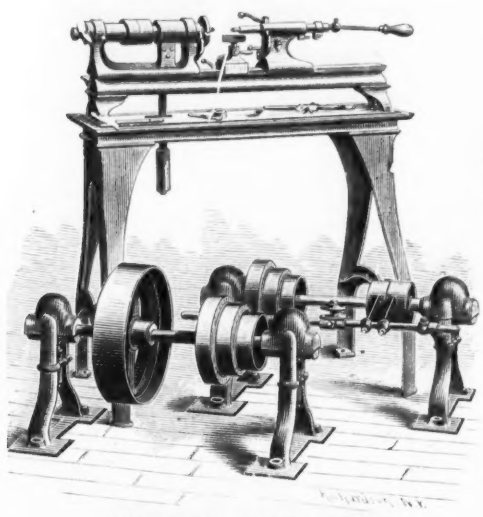

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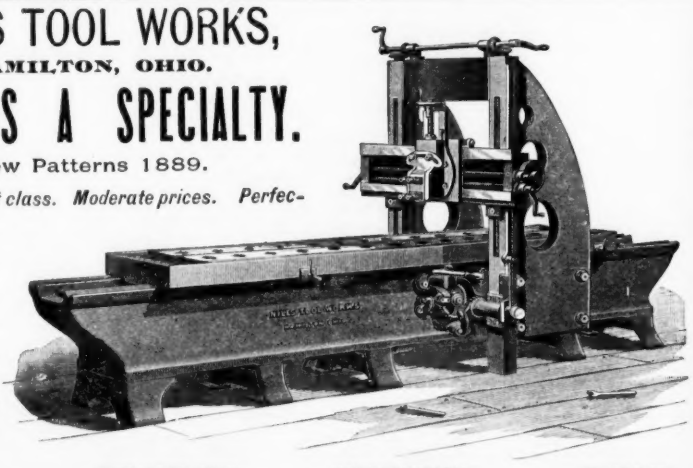

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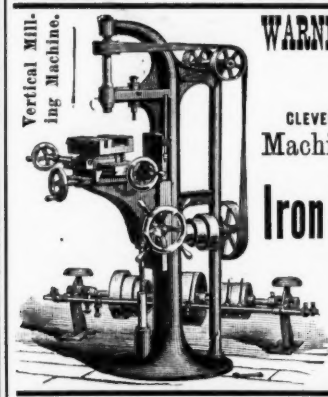

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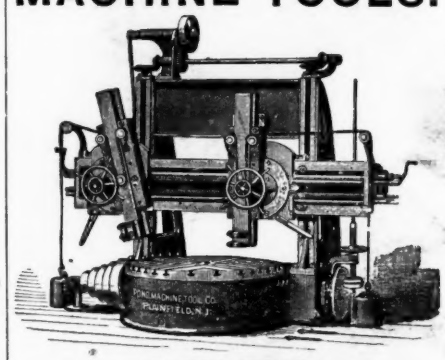

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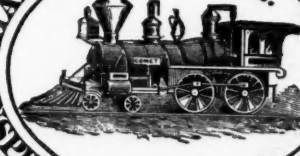

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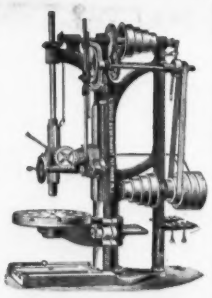

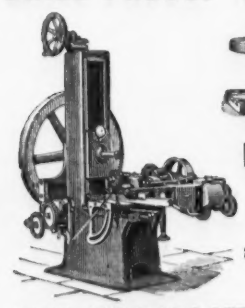

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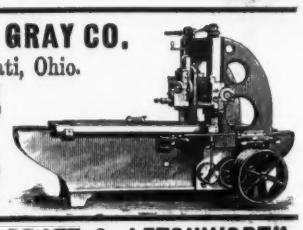

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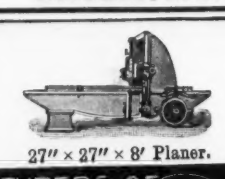

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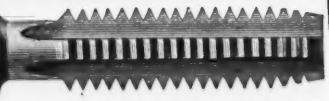

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